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MAINTENANCE SERVICE MANUAL FTC-5010

YAESU MUSEN CO.,LTD.
C.P.O. BOX 1500
TOKYO, JAPAN

YAESU ELECTRONICS CORP.
P.O. BOX 49
PARAMOUNT, CALIFORNIA, 90723

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FOREWORD

The purpose of this manual is to provide information critical to the long-term operation and maintenance of the FTC-5010 UHF FM Mobile Transceiver. In the interest of clarity, descriptions have been kept brief and somewhat informal, while photographs and drawings are utilized liberally.

We believe the material presented herein to be correct and factual. However, should typographical or other errors be present, Yaesu assumes no liability for damage resulting from such errors. Your cooperation in pointing out any inconsistencies in the technical information would be appreciated.

The rugged, straightforward design of the FTC-5010 makes it unlikely that you will have frequent recourse to this manual. We hope and trust, however, that the material to follow will meet your service requirements.

Your attention to the note below is requested.

Yaesu Musen Company, Ltd.
Tokyo, Japan

IMPORTANT NOTE

Any adjustments to the FTC-5010 which affects the transmitter characteristics or operating frequency must be performed only by an FCC licensed technician holding a Second Class (or higher) certificate.

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YAESU
FTC-5010
UHF LAND MOBILE TRANSCEIVER

GENERAL DESCRIPTION

The Yaesu model FTC-5010 is a high-performance, extremely compact FM transceiver for the new General Mobile Radio Service (GMRS) bands. It is a rugged and reliable 1 channel (2 channel transmit) UHF FM transceiver for land mobile operation. The FTC-5010 will operate simplex or through a repeater, with 10 watts of quality FM transmitter output power.

The receiver section features excellent sensitivity, while carefully designed tuned circuits provide outstanding rejection of cross modulation interference. A dual speaker system delivers crisp, clean audio that is necessary to overcome the ambient noise while mobile. Packaged in a heavy-duty case, the FTC-5010 will provide many years of reliable operation.

Available options are the tone squelch unit, horn relay, base station power supplies, and high-performance microphones.

PERFORMANCE SPECIFICATIONS

Frequency range:
RX. 462.55 ~ 462.725 MHz
TX. 462.55 ~ 462.725 MHz
467.55 ~ 467.725 MHz

Number of channels:
Receive: 1 Channel
Transmit: 2 Channels

Oscillation system:
Crystal control

Weight:
1.5 kg

Dimensions:
50(H) x 122(W) x 192(D) mm

Power requirements:
DC 13.8 volts, negative ground

Power consumption:
Standby : Less than 0.1 A
Receive : Less than 0.5 A
Transmit : Less than 3.5 A

TRANSMITTER

Power output:
10 watts

Frequency stability:
Better than ±5 ppm

Modulation type:
16F3

Deviation:
±5 kHz

Audio response:
+1, −3 dB of 6 dB/octave pre-emphasis characteristic from 300 Hz to 3000 Hz

FM noise:
−40 dB @ 1000 Hz, ±3 kHz deviation

Spurious emissions:
At least 60 dB below carrier

AF distortion:
10% or less @ 1000 Hz, ±3 kHz deviation

Antenna impedance:
50 ohms

Microphone type:
Low impedance (600 ohm) dynamic

Crystal multiplication:
x 12

RECEIVER

Sensitivity:
Better than 0.5μV for 20 dB noise quieting
Better than 0.35μV for 12 dB SINAD

Adjacent channel selectivity:
Better than 80 dB

Image rejection:
Better than 80 dB

Intermodulation:
Better than −70 dB

Squelch sensitivity:
0.20μV

AF output:
1.5 watts for Internal Speakers
(@ 8 ohns, 10% THD)
1.5 watts (@ 8 ohms, 10% THD), 3 watts
(@ 4 ohms, 10% THD) for External Speaker.

Specifications subject to change without notice or obligation.

SEMICONDUCTORS

IC

μPC577H	1
M57704H	1
MLM2902	1
MB3756	1
MC3401P	1
AN315	1

FET

3SK76	2

Transistors

2SB856B	1
2SC458B	2
2SC460B	8
2SC535B	9
2SC1906	3
2SC1907	3
2SC2407	1

Silicon diodes

1S1555	11
MC301	3
U05B	1

Varactor diodes

FC52M	2
MV201	1

Light emitting diodes

TLO114	1
GL52RG	1

TONE SQUELCH UNIT

IC

MLM2902	3

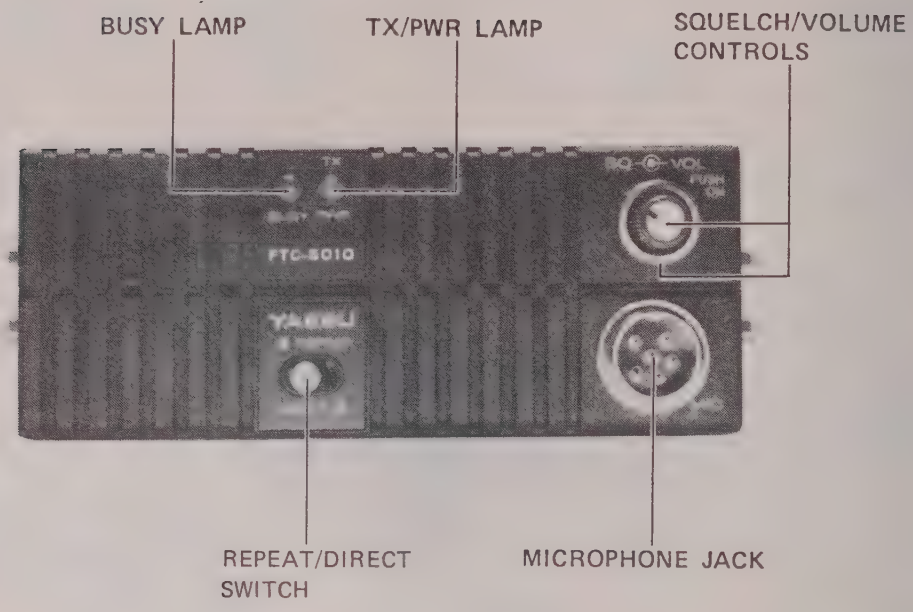
Transistors

2SC460B	9

Silicon diodes

1S1555	4

FRONT PANEL CONTROLS AND SWITCHES



(1) REPEAT/DIRECT

When this switch is placed in the DIRECT position, the transmitter and receiver are on the same frequency. In the REPEAT position, the transmit frequency will be shifted 5 MHz up for repeater operation.

(2) MICROPHONE JACK

This jack accepts the microphone input, push-to-talk control and receiver muting line (see Tone Squelch and Operation).

(3) SQL/VOL

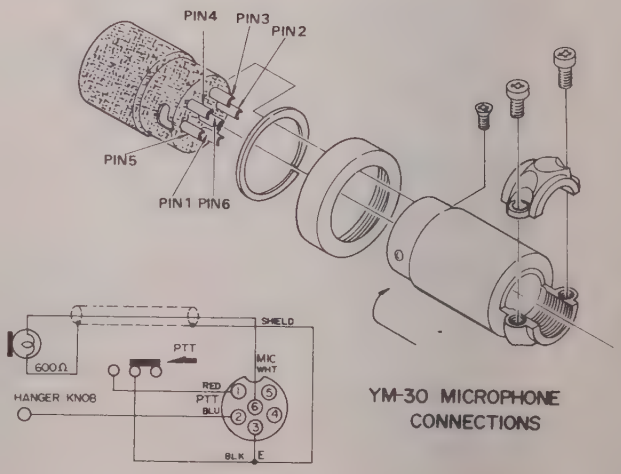
The squelch (SQL) control silences the receiver audio output until a signal is received. The volume (VOL) control sets the receiver volume level. The VOL control should be pushed to turn on the set, and pushed again to turn it off.

(4) TX/PWR LEDs

This lamp will glow red during transmission (TX), and green during standby with DC power applied (PWR).

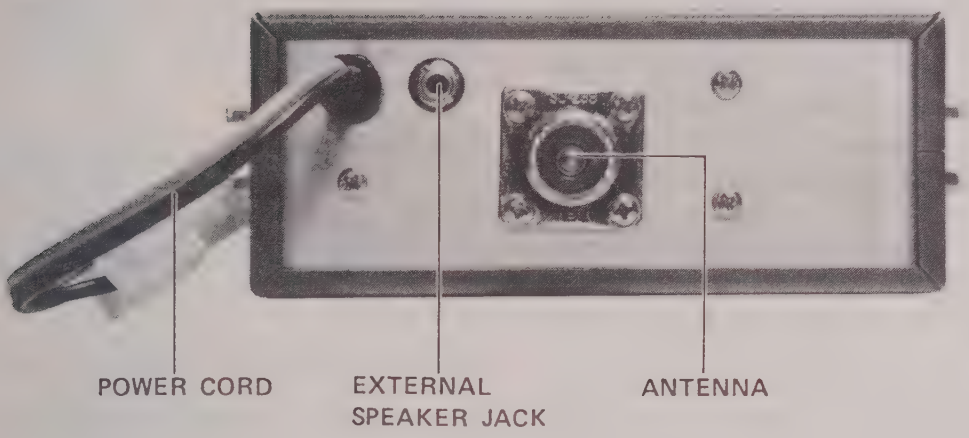
(5) BUSY

This indicator will light up when a signal is received (one strong enough to break the receiver squelch).



YM-30 MICROPHONE CONNECTIONS

REAR APRON CONNECTIONS



(1) POWER

Connect the main DC power cord to this cord stub/connector. Do not apply AC power to this transceiver at any time.

(2) SP

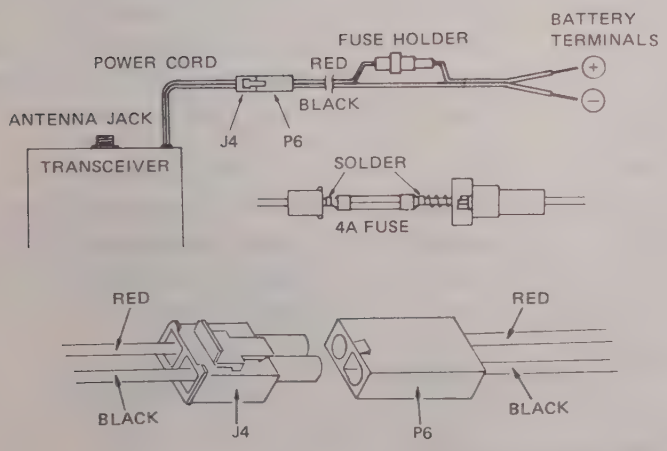
This is a miniature phone jack for connection to an external 4 ohm or 8 ohm speaker.

(3) ANTENNA

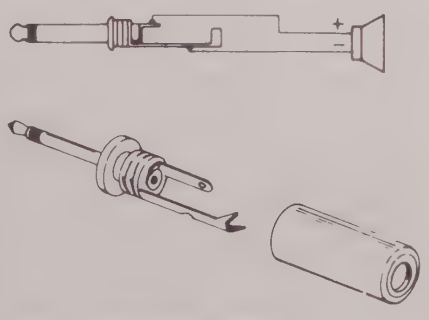
This is a "UHF" connector for connection to the station antenna. The antenna impedance should be 50 ohms.

WARNING

DO NOT CONNECT AC POWER TO THE DC POWER RECEPTACLE. REPLACE FUSES ONLY WITH A 4 AMP FUSE. FAILURE TO OBSERVE THESE WARNINGS WILL VOID THE WARRANTY.



POWER CORD DIAGRAM



Speaker Plug

OPERATION

GENERAL

Included with each transceiver is an "OPERATION MANUAL" which presents basic operating instructions in an easy-to-understand format.

The service technician should become familiar with the operating manual, in order to be able to answer questions that may arise.

The sections to follow are exact reproductions of the corresponding sections of the Owner's Manual. They are presented in this format so as to acquaint you with the terminology familiar to the owner.

HOW TO USE YOUR YAESU FTC-5010 FM TRANSCEIVER

Operation of your YAESU two-way radio is extremely straightforward. The following section will describe the operating procedure.

IMPORTANT NOTE

Before commencing operation, confirm that the power supply connections have been correctly made to rear apron jack and supply. Furthermore, be certain that a 50 ohm antenna is connected to the antenna jack.

Never connect AC power to the rear apron POWER jack.

1. Check to see that all connections have been made correctly.
2. Push the front panel VOL switch to activate the transceiver. The front panel PWR lamp will glow green.
3. Set the REPEAT/DIRECT switch to the appropriate position. (In the DIRECT position, the transmitter and receiver are on the same frequency. In the REPEAT position, the transmitter and receiver frequencies are different, allowing long-distance communications through a repeater.)
4. Rotate the squelch control to the point where the background noise is just silenced.
5. To transmit, squeeze the microphone push-to-talk switch. Release the switch for receiver recovery. The TX lamp will turn red during transmission.

TONE SQUELCH OPERATION (OPTIONAL)

The optional tone squelch (CTCSS) unit will provide for silent monitoring of the busy channels. See your YAESU dealer for installation of the tone squelch option.

Your microphone mounting knob and the microphone hanger form an integral part of the tone squelch system. For proper operation, the microphone hanger must be affixed to the automobile metal body.

Here's how to use the tone squelch system:

1. Place the microphone into its hanger. This will activate the tone squelch system.
2. On receiver, your radio will remain silent until a call is received from a station using an identical tone squelch system. When the correct tone signal is received, normal output from the speaker will occur.
3. To transmit, just remove the microphone from its hanger, and call in the normal manner. When you squeeze the push-to-talk switch, a subaudible tone (one too low for your ear to perceive) will sent along with your voice signal. This will activate the receiver of the other party, in the same way that your receiver responded.
4. Note that when a signal is received which does not have a tone squelch signal on it, the orange BUSY lamp will light up. This will alert you to the fact channel is occupied, even though you cannot hear the calling station. You should wait until the channel is clear before making a call of your own.
5. When you remove the microphone from its hanger, the receiver tone squelch system is defeated, and normal monitoring of all stations on the channel (including those not using tone squelch) will occur.

INSTALLATION

The FTC-5010 is designed primarily for mobile installation, requiring only an antenna and 13.8 VDC power source for operation. The transceiver has been pretuned at the factory, and no adjustment is required for operation into a 50 ohm load.

For mobile installations, three basic factors must be considered. These are: the antenna system and feedline; the physical location of the transceiver; and the power connections. We will consider each of these individually in the following sections.

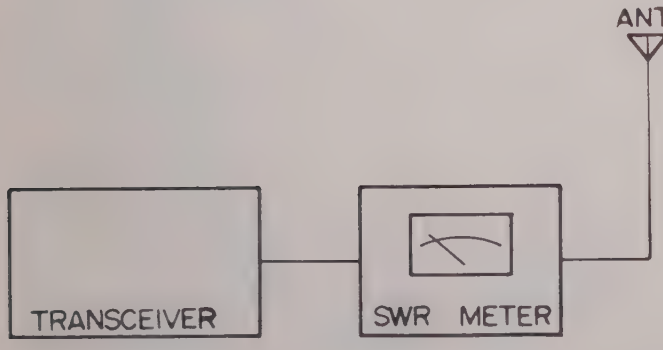
ANTENNA CONSIDERATIONS

The FTC-5010 is designed for operation into a 50 ohm antenna system. While variations of a few ohms from this figure are of no consequence, however, the SWR on the antenna should, if possible, be kept below 1.5:1 at all times to secure full output from the transceiver.

Preferably, the antenna should be located away from the automobile engine, if possible, in order to avoid unnecessary noise pickup. A typical location would be in the center of the car roof or the center of the trunk lid. Where ground connections are made, they should be scraped clean of all paint and corrosion, so as to ensure adequate bonding. Lossy ground connections can have seriously detrimental effects on the antenna system impedance and radiation pattern.

To minimize losses in the antenna system, the shortest possible length of coaxial cable should be used. For mobile installations, type RG-58A/U is suitable because of its small size, with Teflon ® dielectric types being better. For base stations, however, larger sizes are to be preferred. Base station systems requiring more than 25 feet of coaxial cable should utilize type RG-8A/U, and extremely long runs of many hundreds of feet generally require the use of type RG-17A/U, aluminum-jacketed "foamflex" coax, or air-dielectric "heliax" coax.

The antenna should be tuned for the center of the 5 MHz working band of the transceiver. To check the SWR, install a 50 ohm SWR meter between the transceiver antenna jack and the antenna. Place the selector switch into the FORWARD position on the meter, and transmit briefly (make certain that the channel is clear). Rotate the FORWARD SET or SWR SET control for a full scale reading. Now switch to REFLECTED on the meter, and read the SWR. If it is below 1.5, you are in good shape. If not, check below or above the 5 MHz range of the transceiver. If the SWR is very high (more than 3 : 1), there may be trouble in the coaxial cable. Check the SWR with the meter installed **at the antenna,** or test the coax by replacement with cable known to be good.



1. SWITCH TO FORWARD
2. SET METER FOR FULL SCALE
3. SWITCH TO REFLECTED
4. READ SWR ON METER.

TYPICAL SWR TEST SETUP

PHYSICAL LOCATION OF TRANSCEIVER

The FTC-5010 may be installed at any angle desired without loss of performance. Typical locations are atop the transmission tunnel, below or in the dash board, or overhead (in trucks, etc.).

When considering a possible location for the transceiver, several factors must be considered. First, there must be room for the transceiver cables, the microphone, and heat sink. We recommend that several inches of space be available around the heat sink to allow free air circulation. Also, we recommend that the transceiver not be located directly in the path of the output vent from the car heater.

Another consideration is the routing of cables to the desired installation location. If the power cable to the battery or the coaxial cable to the antenna must be extended greatly in order to meet aesthetic considerations, the increased losses may degrade performance. Fortunately, the common under-dash installation lends itself well to efficient performance, as the power cable can be fed through the fire wall.

One final consideration is safety. The transceiver and its microphone must never be installed in a position that may interfere with driver vision or operation of the vehicle. Be especially wary of stick shifts in compact cars, and allow plenty of room for unobstructed manipulation of the controls. The FTC-5010 is very compact unit, so there is no reason ever to compromise safety during installation.

POWER CONNECTIONS

For mobile installation, direct connection to the battery is to be preferred. If power connections are made at the ignition switch, unnecessary noise pickup may occur. Also, if power is taken from the automobile lighting, cigarette lighter, or other circuits, the circuit line fuse will probably blow because of insufficient capacity. A 4 amp fuse is located in the DC power cord for the transceiver, protecting that circuit.

The power connection procedure is detailed below. Once the power connections are made, but before the power cord is connected to the transceiver, you should check the battery charging voltage with the engine running fast enough for the car ammeter to show a charge. If the voltage exceeds 15 volts, the car voltage regulator must be adjusted to limit the maximum voltage to less than 15 volts.

Also, when making power supply connections, you must be absolutely certain that the proper supply polarity is observed.

WARNING

NEVER APPLY AC POWER TO THIS TRANSCEIVER. NEVER CONNECT A DC POWER SOURCE OF GREATER THAN 15 VOLTS TO THE REAR PANEL POWER JACK. ALWAYS REPLACE FUSES WITH A FUSE OF THE PROPER RATING. FAILURE TO OBSERVE THESE SIMPLE PRECAUTIONS WILL VOID ALL WARRANTIES ON THIS EQUIPMENT.

INSTALLATION STEP-BY-STEP OUTLINE

1. Determine the optimum location for the transceiver, making certain that there is sufficient space for the transceiver, its cables and switches, and the microphone. Leave several inches of space around the heat sink, to permit free air flow.

2. A universal bracket is supplied with the transceiver. Use the universal bracket as a template for positioning the mounting holes. Use a 3/16" diameter bit for drilling these holes, allowing clearance for the transceiver and all accessories and cables. Secure the mounting bracket with the screws, washers, and nuts supplied, as shown in the drawing.

3. Ease the transceiver into the guide rail, and slide it into the desired position. Tighten the knobs on the outside of the universal bracket to secure the transceiver.

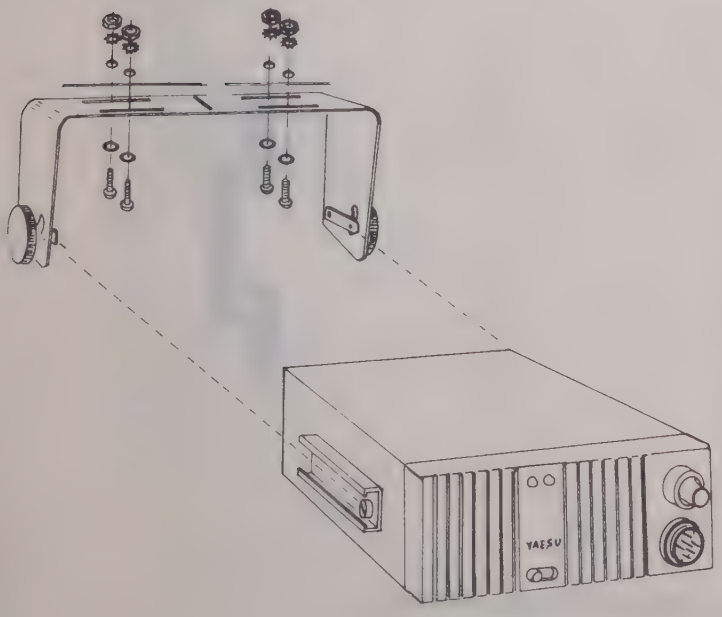
4. The key lock mechanism may be mounted either on the left or right side of the mounting bracket. Just remove the four screws holding the cover plate on the bracket, and install the key lock in its place. The plate can then be installed on the side opposite the lock.

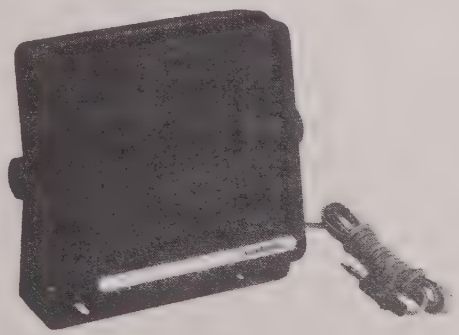
5. Confirm that the installation does not obstruct normal, safe operation of the vehicle.

6. Route the transceiver power cable through the fire wall to the battery. Avoid proximity to ignition cables if at all possible. Lay out the power cable so as not to have it interfere with the normal operation of the fan belt or other engine components.

7. Connect the RED battery lead to the POSITIVE (+) side of the battery. Connect the BLACK lead to the NEGATIVE (–) side of the battery.

8. If the optional FSP-1 (8 ohms impedance) or FSP-2 (4 ohms impedance) external speaker is to be installed, it may be connected to the rear apron SP jack. The speaker can then be mounted wherever convenient for the operator. Insertion of the speaker plug into the rear apron automatically cuts off the internal speaker of the transceiver.





FSP-1/FSP-2
EXTERNAL SPEAKER

BASE STATION INSTALLATION

For base station installations, the FP-5 AC power supply option provides a convenient means of providing the required 13.8 VDC for the FTC-5010, transceiver.

Before commencing operation with the FP-5, be absolutely certain that the power transformer primary has been wired correctly for the local line voltage in your area. The FP-5 is marketed throughout the world, and a unit that you receive from a customer who recently has been abroad may be wired for 234 volts or similar. Operation of the FP-5 from an improper supply voltage will void all warranties on the set.

For installation to the FP-5, connect the two pin cord stub/connector J4 to the internal connector P1 of the FP-5.

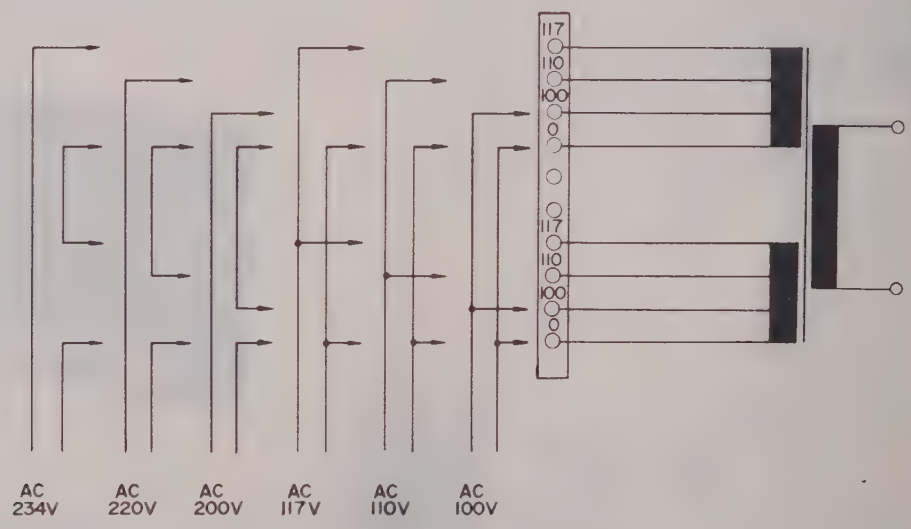
Plug in the FP-5 AC cable to the wall outlet. Now turn the power supply switch ON, and then turn the transceiver power switch ON. The radio will now be ready for operation, if you have the antenna and microphone connected.

The FP-5 contains a quality speaker for base station installation. Connect the miniature phone plug from the FP-5 to the SP jack on the rear apron of the transceiver.

CAUTION

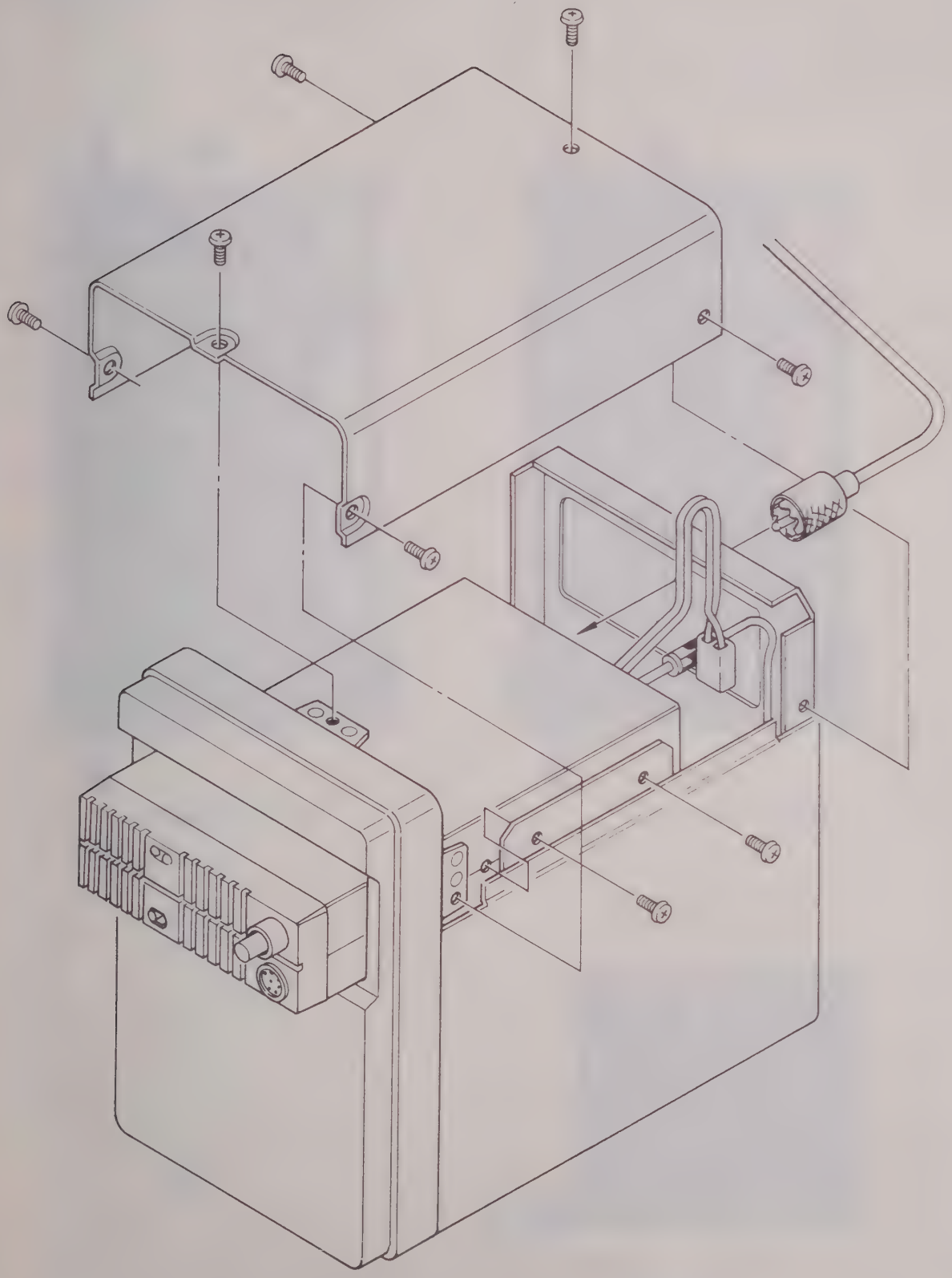
When performing service on the FP-5, be absolutely certain that the voltage specification on the rear apron matches your local supply voltage. Improper connections will void our warranty.

FP-5



POWER TRANSFORMER PRIMARY CONNECTIONS

INTERCONNECTIONS

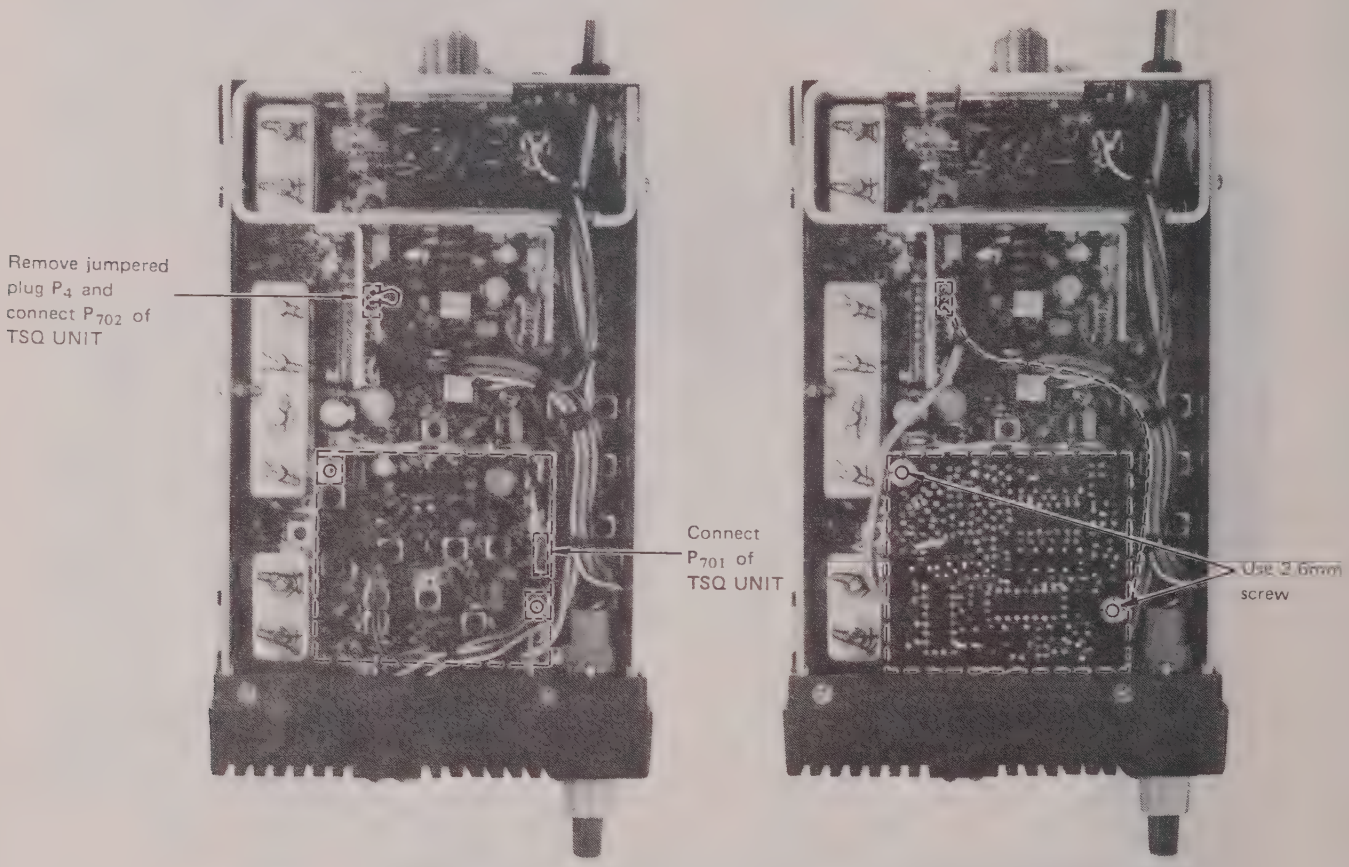


TONE SQUELCH INSTALLATION

The FTS-2 CTCSS module option can easily be installed in a matter of minutes. Inspect the frequency table accompanying this section, and select the resistor appropriate for the tone signal to be used. Install the selected R_{764}, and R_{765}, onto the FTS-2/PB board, and be certain to use only a 0.5% tolerance metal film resistor.

Refer to Figure 1, and unplug P_4 from its jack J_{101}. Install the FTS-2 into correct position and connect P_{702} into J_{101}, and P_{701} into J_{201}.

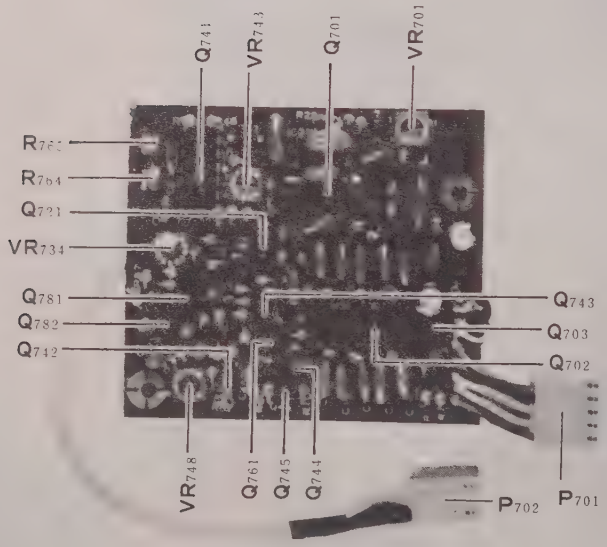
* US models use the FTS-32ED module. See your Yaesu dearler for details of the FTS-32ED for the US model.



Before Installation

After Installation

Figure 1



Tone Squelch Unit
FTS-2

TONE SQUELCH TUNING RESISTOR CHART

Tone Freq.	R_{764}	R_{765}
67.0 (Hz)	1 (MΩ)	374 (kΩ)
71.9	〃	191
74.4	〃	115
77.0	〃	40.2
82.5	562 (kΩ)	344
85.4	〃	284
88.5	〃	226
91.5	〃	174
94.8	〃	124
100.0	〃	54.9
103.5	442	133
107.2	〃	95.3
110.9	〃	59.7
114.8	300	169
118.8	〃	137
123.0	〃	107
127.3	〃	80.6
131.8	〃	54.9
136.5	〃	30.9
141.3	〃	8.87
146.2	137	152
151.4	〃	132
156.7	〃	114
162.2	〃	97.6
167.9	〃	81.6
173.8	〃	67.3
179.9	〃	53.6
186.2	68.1	110
192.8	〃	97.6
203.5	〃	80.6
210.7	〃	70.6
218.1	〃	61.9
225.7	〃	53
233.6	〃	44.8
241.8	〃	37.4
250.3	〃	30.5

Table 1

THEFT GUARD INSTALLATION USING FHR-1

The Theft Guard feature of the FHR-1 Horn Relay box can be an effective deterrant to burglary. When the line from the FHR-1 box to the FTC-5010 is cut, the horn will begin blaring on and off, and further tampering with the car will probably be discouraged.

In order to make it difficult for a thief to disable the Theft Guard, we recommend that the FHR-1 be installed under the hood of the automobile in a fairly dry location. Alternatively, it may be installed in some inaccessible location under the dash. The only time that ON/OFF switching should be needed is in the event of an attempted burglary, as the current drain is negligible in the standby mode. To quiet the horn, turn the FHR-1 power switch to OFF.

Installation Procedure:

(1) Refer to Figure 2 and mount the FHR-1 box in the desired location. The unit is not waterproof, so a position not exposed to moisture is to be preferred.

(2) Refer to the interconnection diagram (Page 2-5), and hook up the wires as shown. The two heavy red wires (bare ends, with no connector) should be wired in parallel with the main steering wheel horn switch of the car. The three leads from the molded connector are connected as follows: the white lead goes to the FTC-5010 HORN RELAY terminal (Figure 3); the red lead goes to an auxiliary post on the fuse block, if one is available (10 amp fuse is OK); the black lead goes to ground.

(3) Inside the FHR-1 are two miniature potentiometers, shown in Figure 4, VR_{101} controls the ON time of the beeping horn; while VR_{102} controls the OFF time. Either control provides an adjustment range of 2 to 25 seconds in the on and off times.

(4) The customer should be educated in the importance of being able to turn off the horn relay quickly, so as to minimize the disturbance to others. Also, discuss with the customer the importance of maintaining good connections to the HORN RELAY jack, etc., so as not to induce false triggering of the horn.

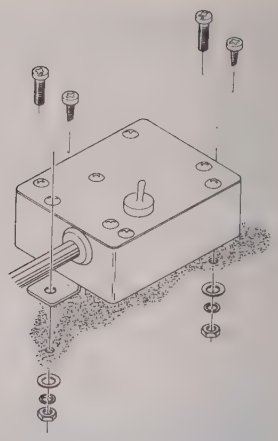


Figure 2.

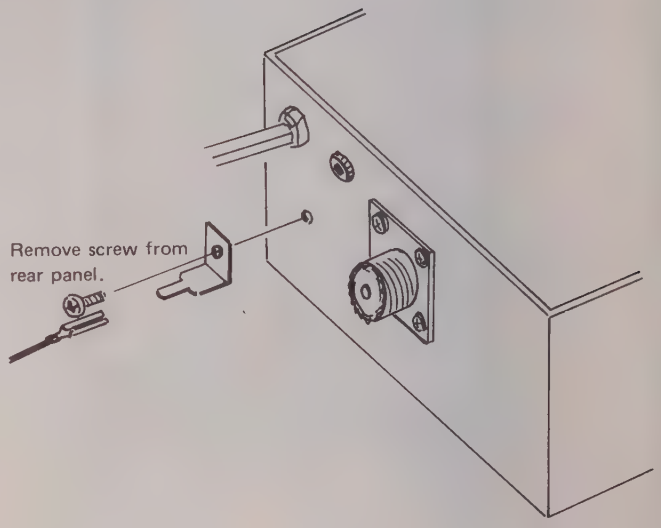


Figure 3.

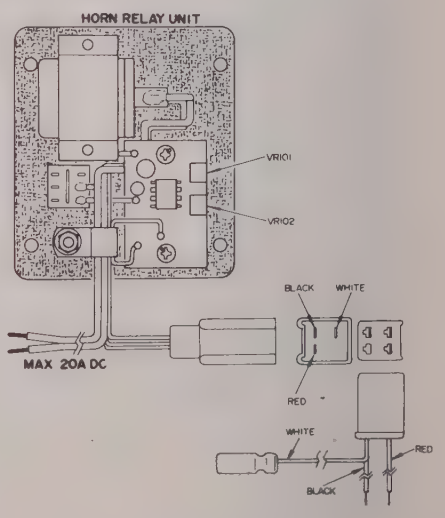
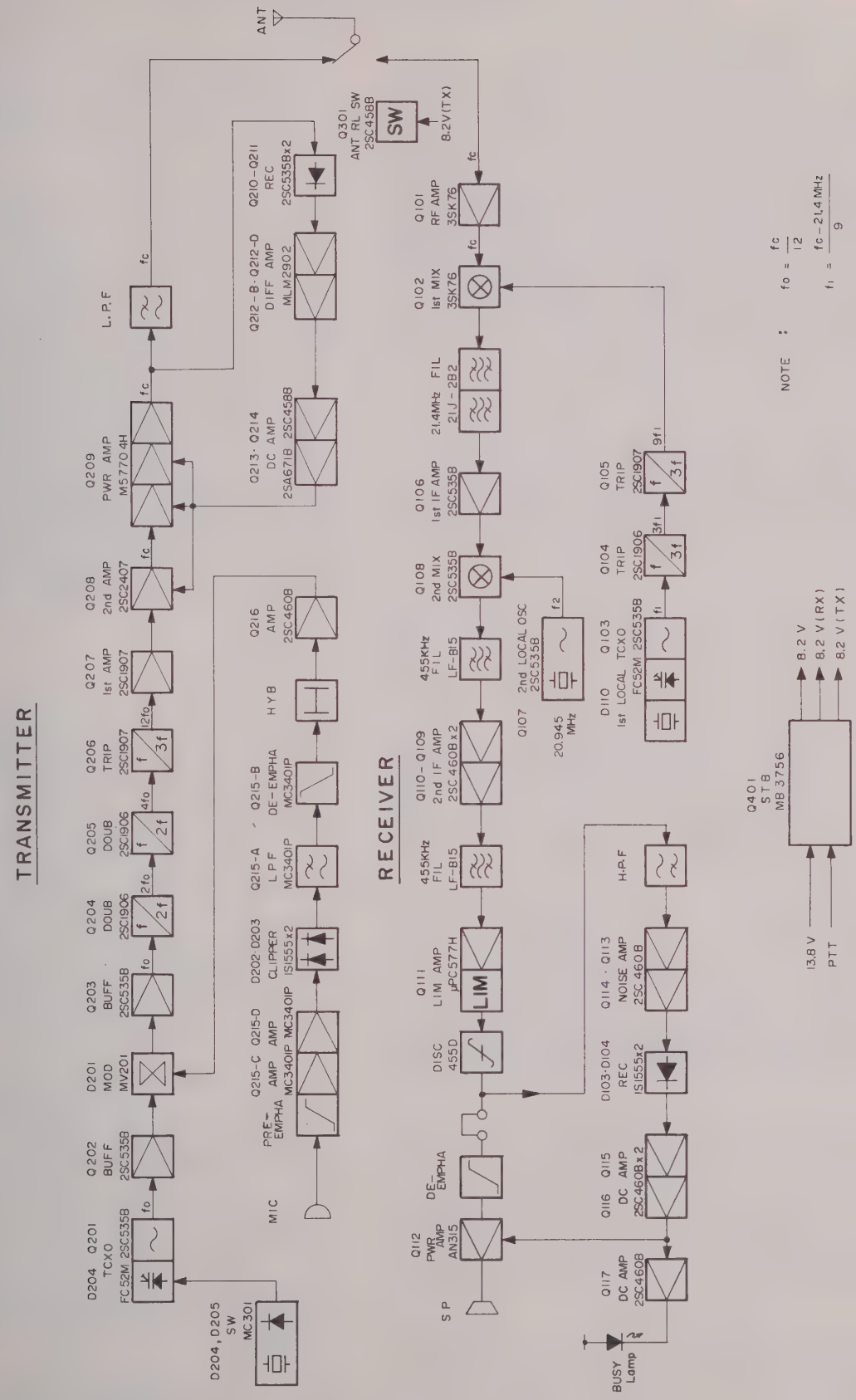


Figure 4.

BLOCK DIAGRAM



CIRCUIT DESCRIPTION

RECEIVER

The incoming signal from the antenna is coupled through helical resonator CV_{101} to RF amplifier Q_{101} **(3SK76)**, a dual-gate MOS FET with excellent rejection of cross modulation. The amplified signal is then passed through a four-stage helical resonator to the first mixer, where the RF signal is mixed with the first local signal delivered from Q_{103} **(2SC535B)**, resulting in a 21.4 MHz first IF. Local oscillator Q_{103} uses single HC-25/U crystal operating in the third overtone mode, and T_{108} allows precise adjustment of the channel frequency. The output from Q_{103} is coupled through C_{137} to oscillator multipliers Q_{104} **(2SC1906)** and Q_{105} **(2SC1907)**, then link coupled through CV_{103} to gate 2 of the first mixer, Q_{102} **(3SK76)**.

The output from the first mixer is tuned by T_{105} to the difference frequency of the input signals, then passed through monolithic crystal filters XF101 and XF102 and amplified by Q_{106} **(2SC535B)**. The IF signal is then delivered to the second mixer, where the 21.4 MHz first IF signal is mixed with a 20.945 MHz local signal generated by Q_{107} **(2SC535B)**, producing a 455 kHz second IF.

The second IF signal is fed through filter CF_{101}, amplified by Q_{109} and Q_{110} **(2SC460B)**, and fed through another ceramic filter, CF_{102}. The IF signal is then fed to amplifier/limiter Q_{111} **(μPC577H)**. The limiting action of Q_{111} eliminates any amplitude variation in the IF signal, which subsequently is fed to the discriminator.

The discriminator consists of D_{101}/D_{102} **(1S1555)** and CD_{101}, a ceramic discriminator element. The output from the limiter is coupled through C_{179} to CD_{101}, then rectified by D_{101} and D_{102}, producing an audio output in response to a corresponding frequency shift in the IF signal.

The audio output signal from the discriminator is fed to a notch filter, which tunes out the 455 kHz IF signal present. The signal is then fed through pin 1 of J_{101} to the optional tone squelch unit. When the tone squelch unit is not installed, the signal is fed via a jumper to the de-emphasis network, consisting of R_{147} and C_{185}. The de-emphasized audio output is fed through the audio volume control, VR1b, to audio amplifier Q_{112} **(AN315)**, which delivers 1.5 watts of audio output power to the speaker.

When no carrier is present in the 455 kHz IF, the high frequency noise present at the discriminator output is amplified by Q_{113} and Q_{114} **(2SC460B)**, then detected by D_{103} and D_{104} **(1S1555)**, producing a DC voltage. This voltage is amplified by Q_{115} and Q_{116} **(2SC460B)** and fed to pin 10 of Q_{112}, cutting off the audio amplifier. A portion of the DC voltage is also used to control Q_{117} **(2SC460B)** for BUSY lamp operation. When a carrier is present in the 455 kHz IF, the noise is removed from the discriminator output, and the audio amplifier then recovers to normal operation. The opening of the squelch causes Q_{117} to be activated, causing the BUSY lamp to become illuminated.

TRANSMITTER

The speech input signal from the microphone is amplified by Q_{215} C, D **(MC3401P)** and coupled through C_{254} to the instantaneous deviation control (IDC), consisting of D_{202} and D_{203}. In the Q_{215} C, D amplifier stages, the audio is also applied through a pre-emphasis network, consisting of C_{251}, R_{245}. The output from the IDC is then fed to a de-emphasis network and fed through a low-pass filter, consisting of $R_{254}-R_{257}$, $C_{256}-C_{258}$. The resulting audio signal, free of components above 3 kHz, is fed to the modulator.

Crystal oscillator Q_{201} **(2SC535B)** generates a fundamental signal, with temperature compensation provided by D_{206} **(FC52M)**, TH_{202} **(STD-100)**, and TH_{201} **(STD-1000)**. The carrier signal is fed through buffer Q_{202} **(2SC535B)** to the phase modulator, consisting of D_{201} (MV201) and associated circuitry. The carrier signal from Q_{202} is varied in phase by the audio signal from Q_{216}, and the resulting modulated signal is amplified by Q_{203} **(2SC535B)**.

The frequency multiplier stages consist of Q_{204}, Q_{205} **(2SC1906)**, and Q_{206} **(2SC1907)**; the total multiplication factor is 12. The output from Q_{206} is amplified by Q_{207} **(2SC1907)**, Q_{208} **(2SC2407)**,

and Q_{209} **(M57704H)**. The RF output signal is fed through a low pass filter, consisting of L_{216}, L_{217}, L_{218}, C_{246}, C_{247}, C_{248}, C_{249}, C_{250}, C_{289} and C_{306}. The RF signal is then fed through antenna relay RL_{301} to the antenna connector.

Automatic Power Control (APC) Circuit

A portion of the RF signal from Q_{209} is coupled through stray capacitance on the circuit board trace to the base of Q_{210} **(2SC535B)**, which acts as a rectifier. The resulting DC voltage is fed to section (d) of Q_{212} **(MLM2902)**, where it is compared with a reference voltage delivered from Q_{211} **(2SC535B)**. The DC voltage is then fed through a DC amplifier at Q_{212} (b), Q_{214} **(2SC458B)**, and Q_{213} **(2SB856)** to Q_{209} on the RF power module, controlling the supply voltage to the final amplifier stage.

TONE SQUELCH UNIT

The tone squelch unit is comprised of a HPF, LPF, BPF, oscillator and control circuits.

(1) HPF

The output signal from the discriminator is fed through VR_{701} to buffer amplifier Q_{701b} **(MLM2902)** and then delivered to the HPF and LPF circuits. The HPF consists of four 12 dB/oct active filter stages. $Q_{702a\text{-}d}$ **(MLM2902)** rejects the unwanted CTCSS tones while a buffer stage acts as a switch for the AF amplifier.

(2) LPF

A portion of the output signal from Q_{1b} is passed through the LPF consisting of three stages of 12 dB/oct active low-pass filters which pass only CTCSS tone signals. The output signal from the LPF is clipped by D_{701} and D_{702} (both **1S1555**) for stable operation against the varying input level. The clipped CTCSS tone signal is applied to the BPF circuit.

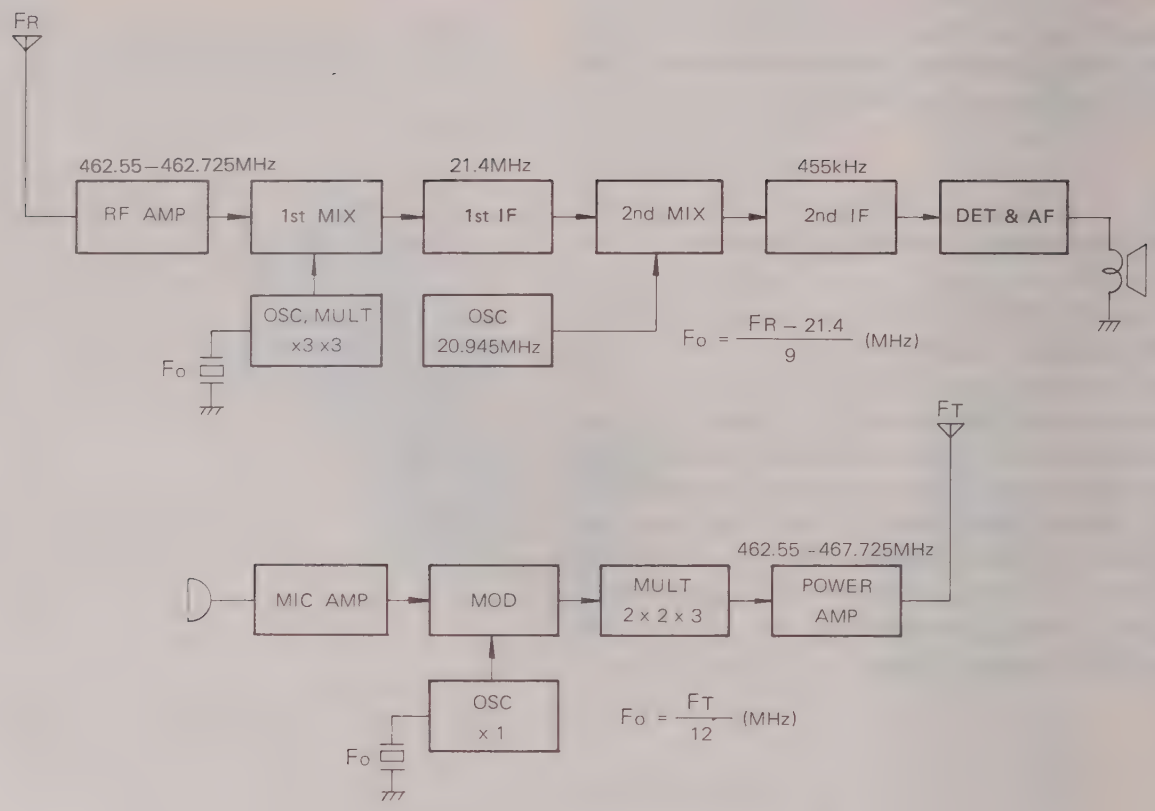
(3) BPF

The BPF circuit which consists of $Q_{741\,b\text{-}d}$ **(MLM2902)** is extremely stable. The filtered tone signal from the BPF is amplified by $Q_{741\,a}$ and activates the control circuit. Frequency setting is accomplished by R_{764} and R_{765}; VR_{743} for fine tuning.

(4) Control circuit

On receive, the CTCSS tone signal is rectified by Q_{743} **(2SC460B)** and amplified by DC amplifiers Q_{744} and Q_{745} (both **2SC460B**). The output DC voltage activates the Q_{761} **(2SC460B)** to mute the receiver.

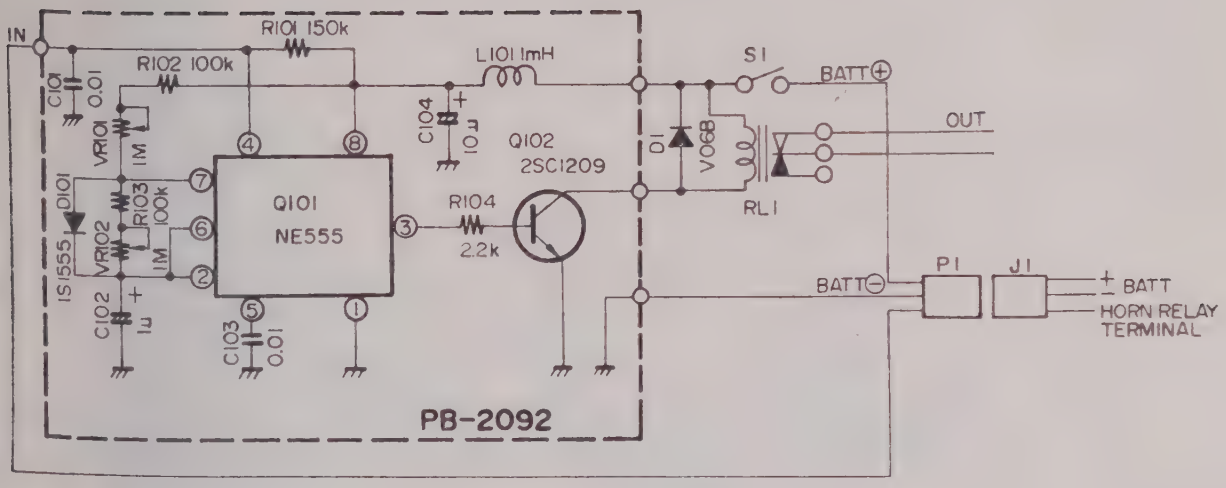
On transmit, switching transistor Q_{782} **(2SC460B)** conducts to activate the amplifier Q_{781} **(2SC460B)**, while the BPF provides the feedback needed to start oscillation at specified tone frequency. The oscillated tone signal is amplified by Q_{742} **(2SC460B)** and fed through P_{711} to Q_{216} in the IDC circuit.



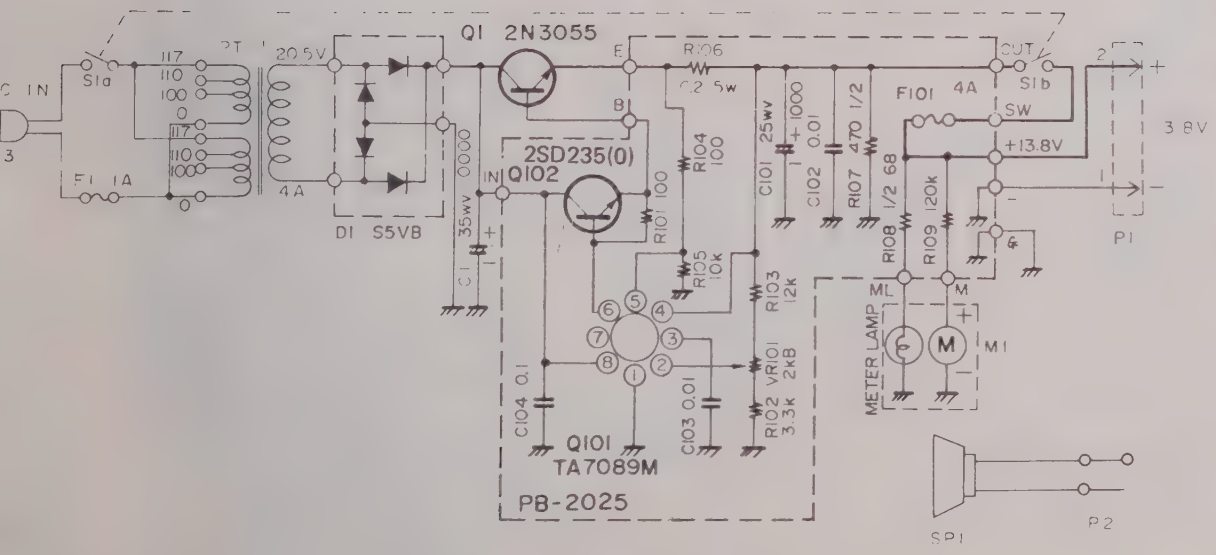
CRYSTAL DATA

1. Type of holder:	HC-25/U or HC-42/U
2. Channel Frequency:	460 MHz ~ 470 MHz
3. Oscillation Frequency:	TX: CH/12 RX: (CH–21.4 MHz)/9
4. Load Capacity:	TX: [redacted] Series RX: [redacted] "
5. Drive Level:	TS-683/TMS 2mW
6. Shunt Capacity:	TX: 4.5pF±0.5pF RX: 4.8pF±0.5pF
7. Frequency Tolerance:	±10ppm at 25°C
8. Frequency Stability:	+8ppm ~ 0ppm at –20°C to –3ppm ~ –13ppm at +60°C (25°C reference)
9. Equivalent Resistance:	17Ω max (series)
10. Operation Mode:	3rd order overtone

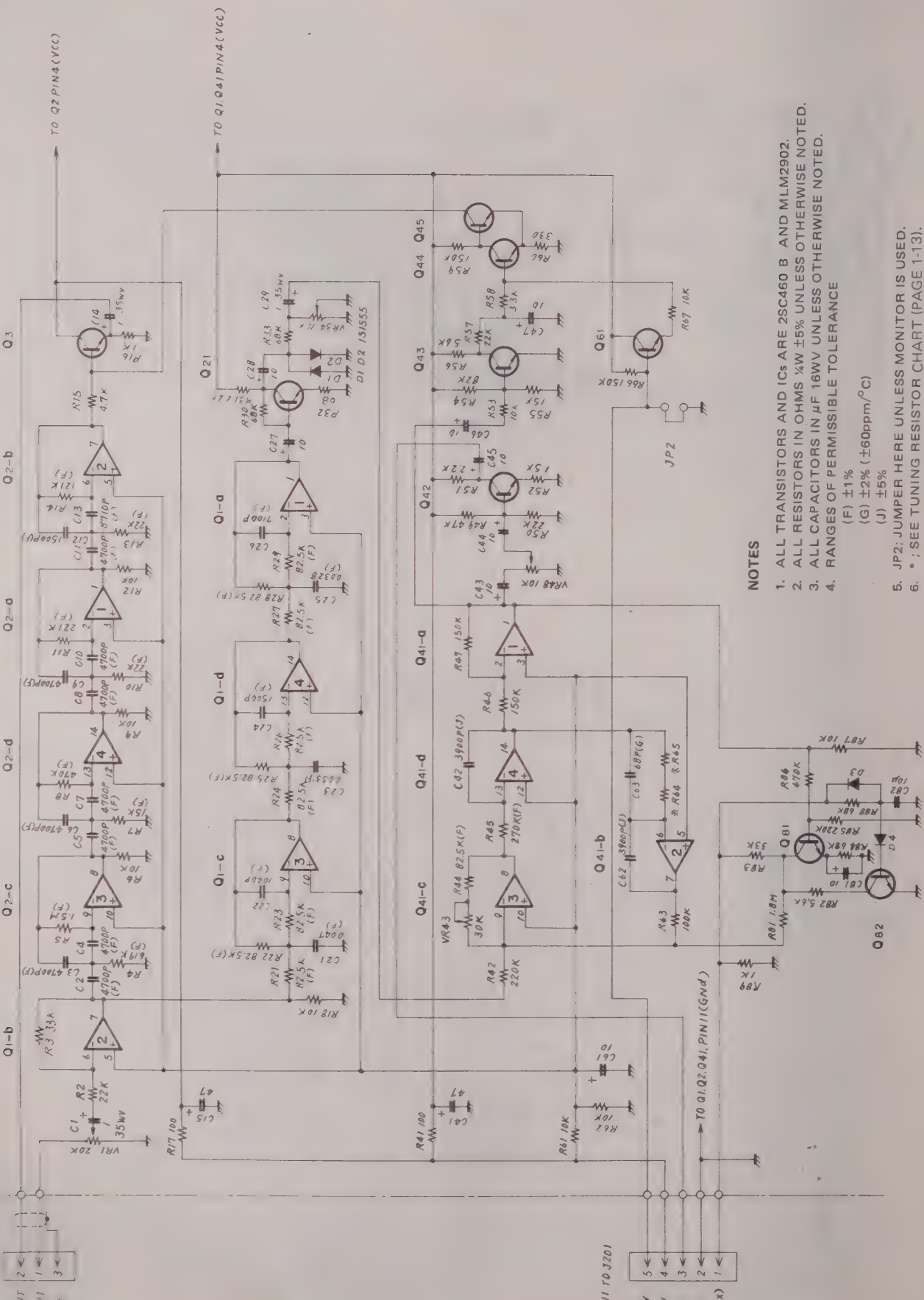
HORN RELAY UNIT
FHR-1



AC POWER SUPPLY
FP-5



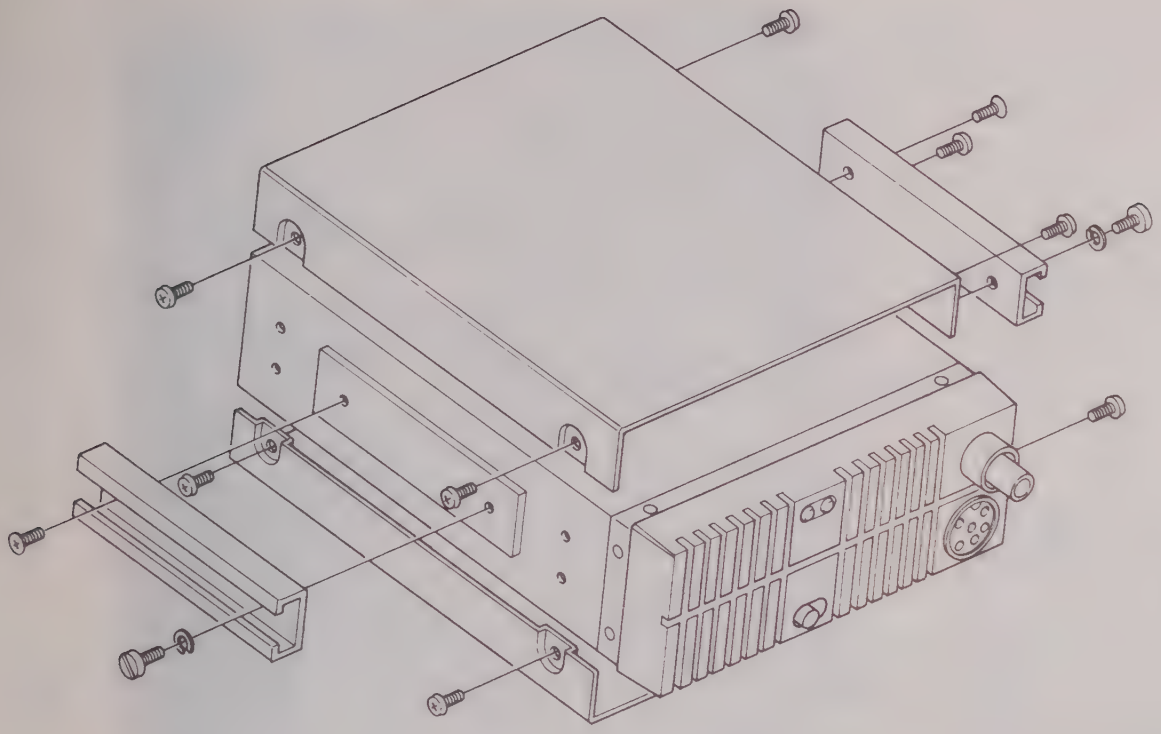
FTS-2 TONE SQUELCH UNIT



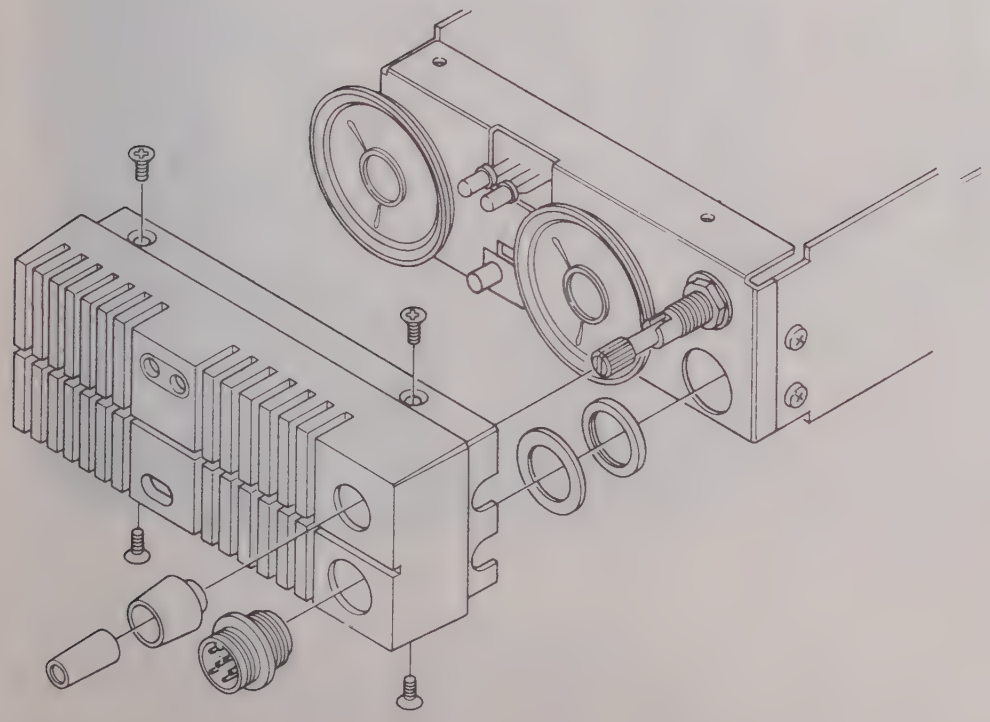
NOTES

1. ALL TRANSISTORS AND ICs ARE 2SC460 B AND MLM2902.
2. ALL RESISTORS IN OHMS ¼W ±5% UNLESS OTHERWISE NOTED.
3. ALL CAPACITORS IN μF 16WV UNLESS OTHERWISE NOTED.
4. RANGES OF PERMISSIBLE TOLERANCE
   (F) ±1%
   (G) ±2% (±60ppm/°C)
   (J) ±5%
5. JP2; JUMPER HERE UNLESS MONITOR IS USED.
6. * ; SEE TUNING RESISTOR CHART (PAGE 1-13).

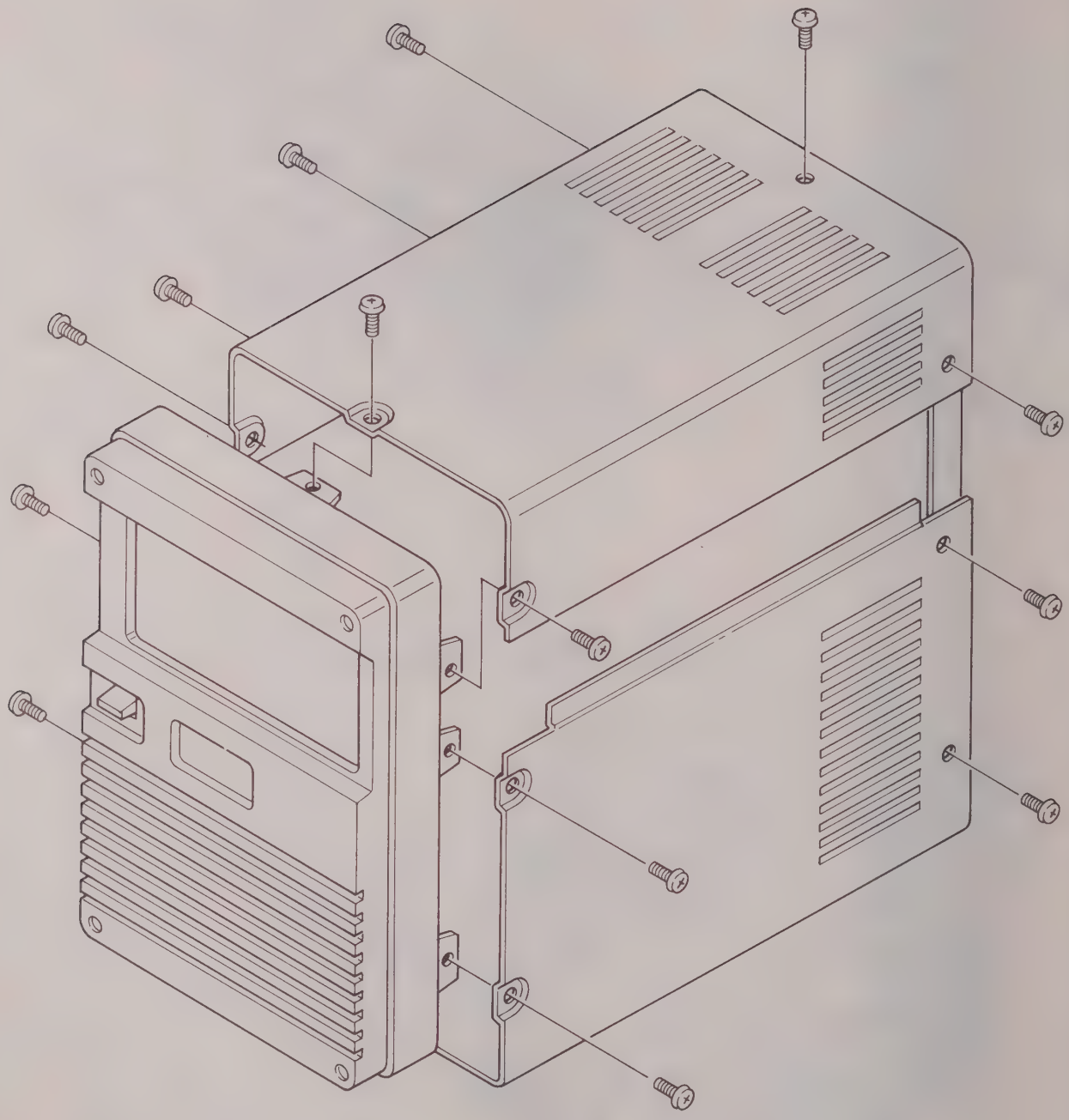
OUTER COVER REMOVAL



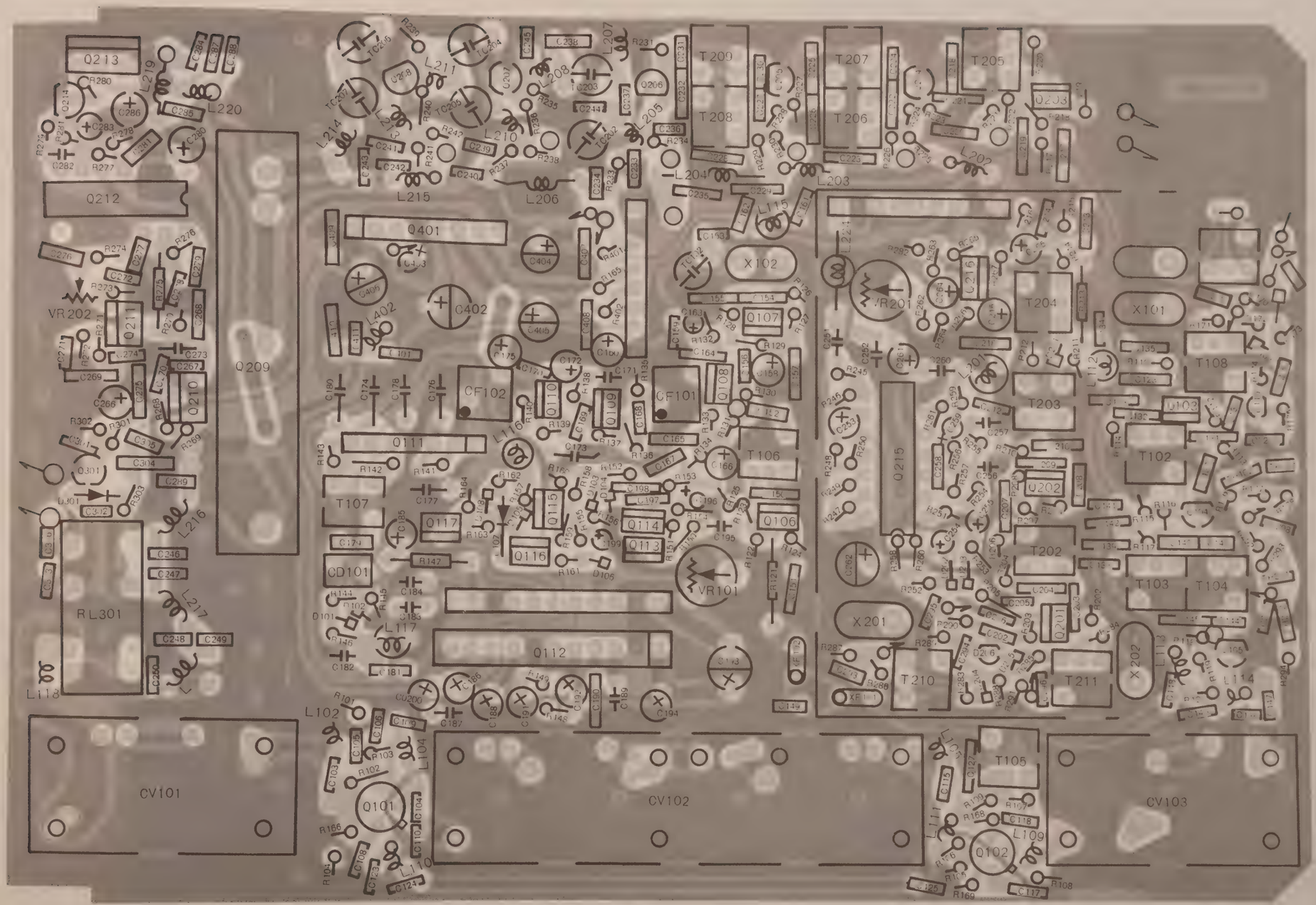
FRONT PANEL REMOVAL



FP-5 OUTER COVER REMOVAL



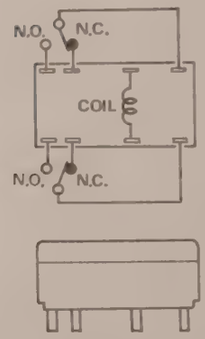
PARTS LAYOUT (MAIN BOARD)



Viewed from Component Side

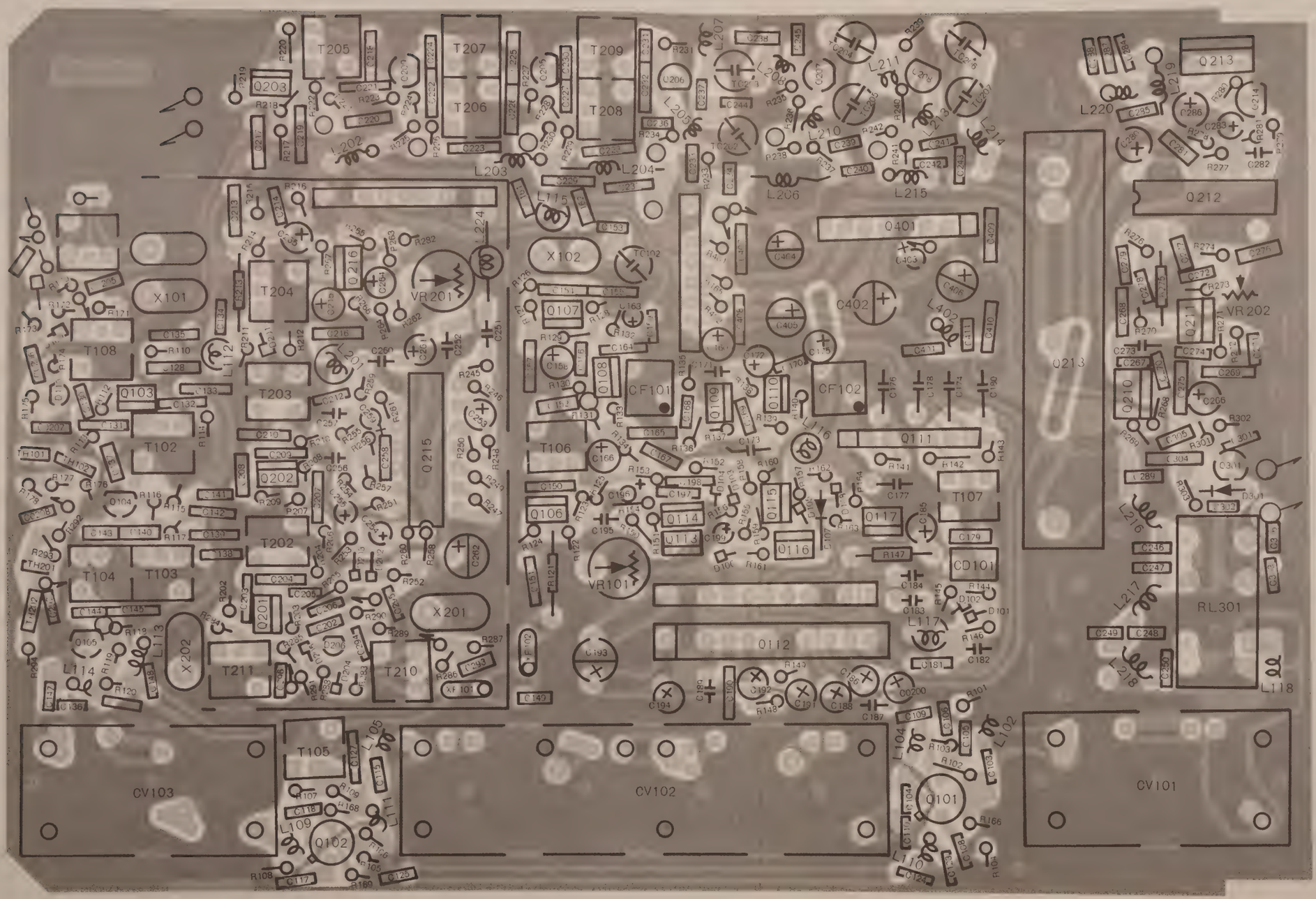
RELAY CONNECTIONS

RL301 FBR221 D006



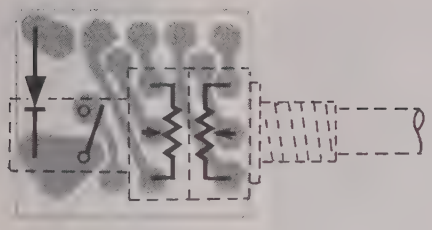
SIDE VIEW

PARTS LAYOUT (MAIN BOARD)

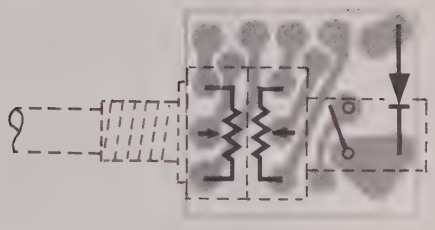


Viewed from Solder Side

VR UNIT PARTS LAYOUT

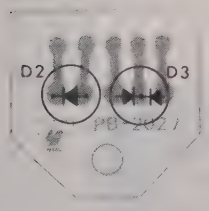


Viewed from Component Side



Viewed from Solder Side

LED UNIT PARTS LAYOUT

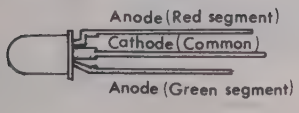


Viewed from Component Side

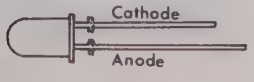
A—Anode
K—Cathode
(R)—Red segment
(G)—Green segment

Viewed from Solder Side

GL-52RG

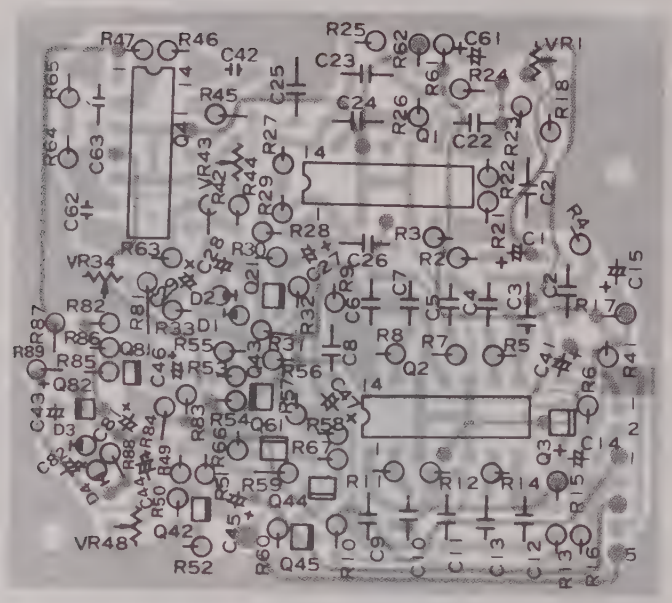


TLO-114

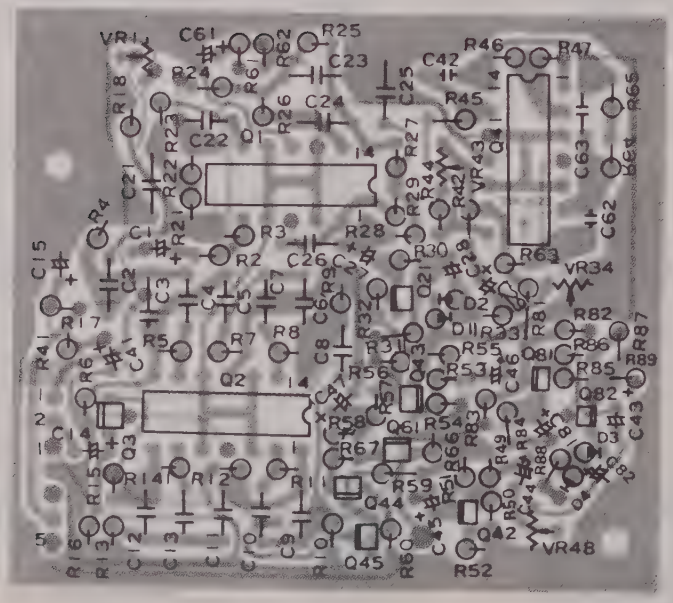


LED Connections

TONE SQUELCH UNIT PARTS LAYOUT

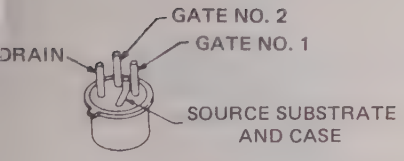


Viewed from Component Side

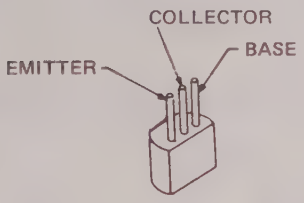


Viewed from Solder Side

SEMICONDUCTOR CONNECTIONS



3SK76



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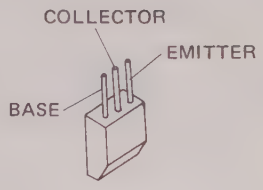
2SC1906
2SC1907



2SC535A/B
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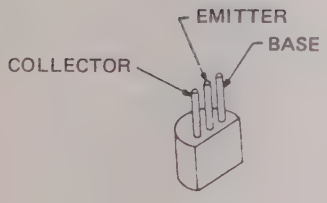

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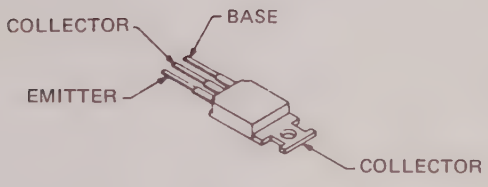

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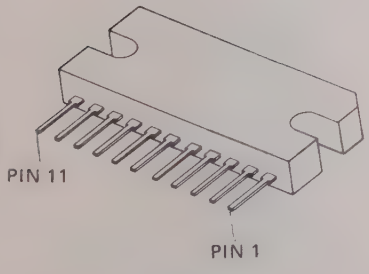

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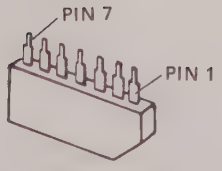
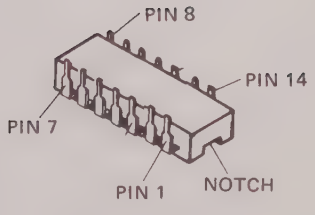
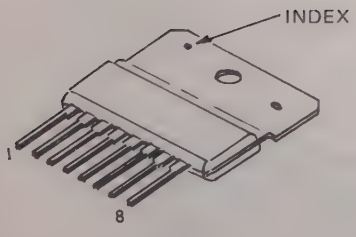


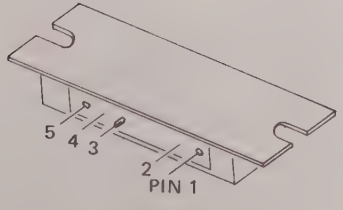
μPC577H



MLM2902
MC3401P

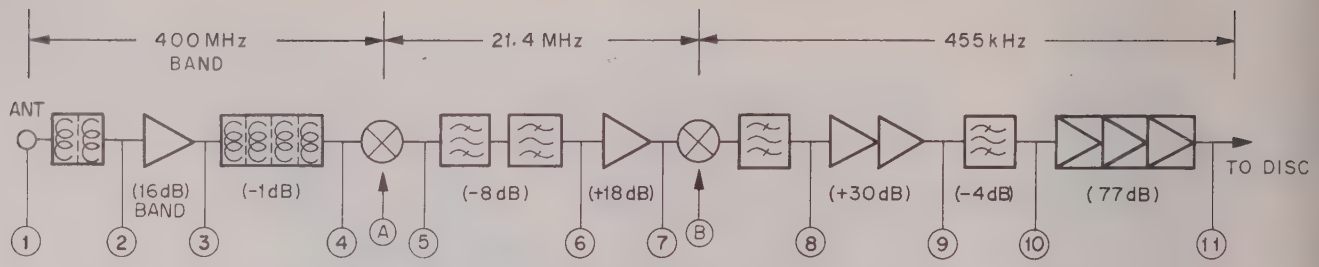


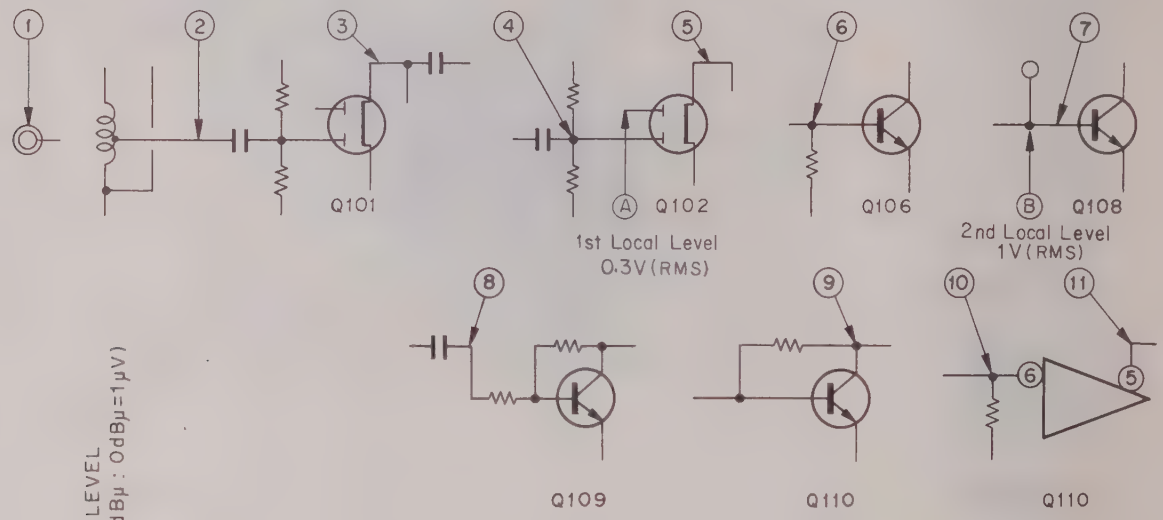
MB3756

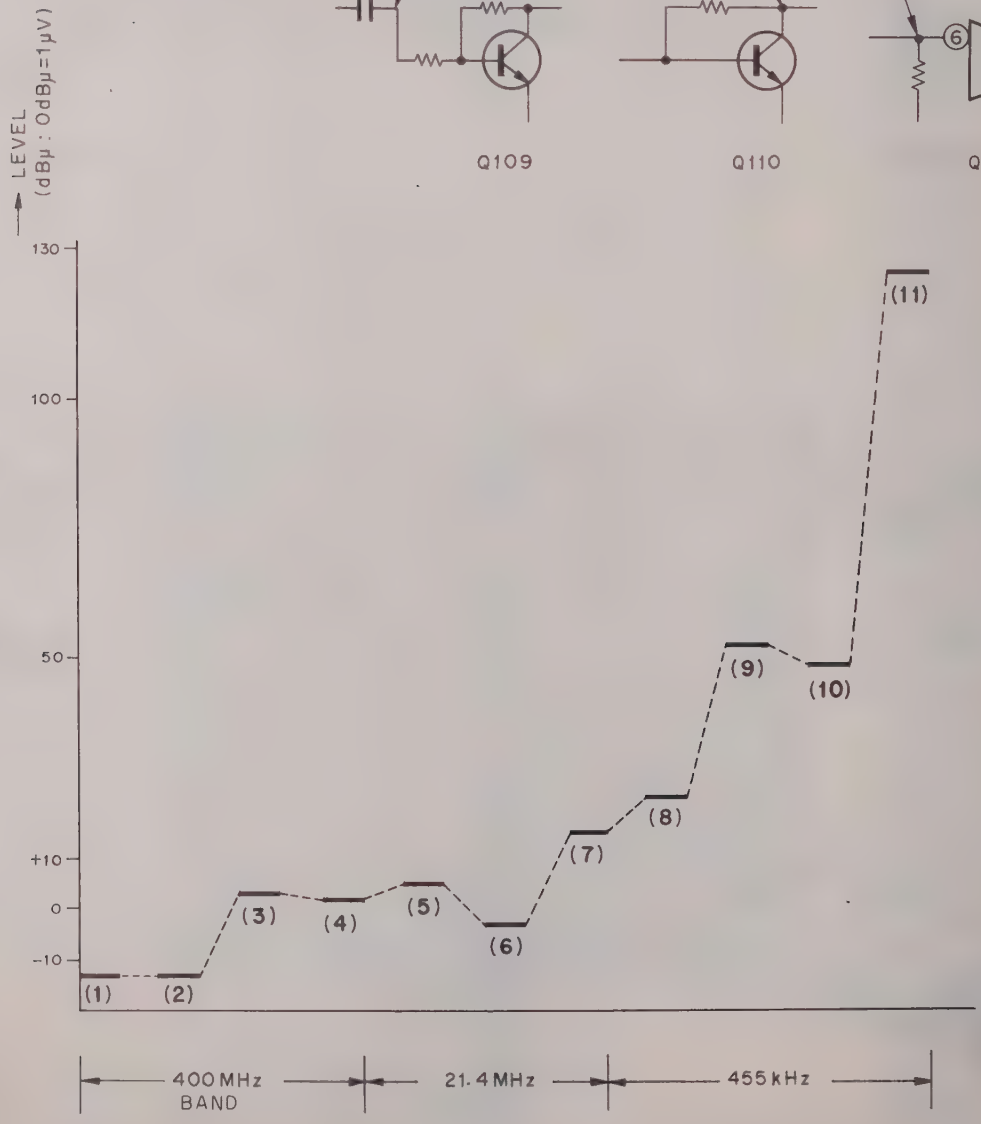


M57704H

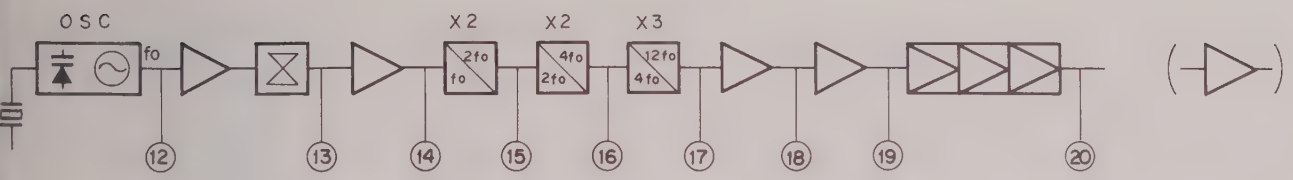
LEVEL DIAGRAM (RECEIVER SECTION)

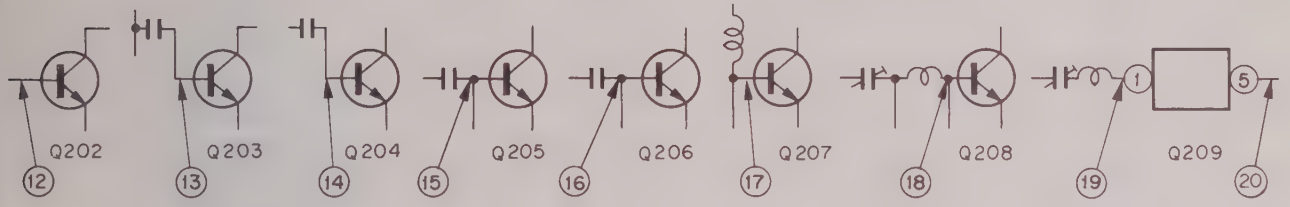


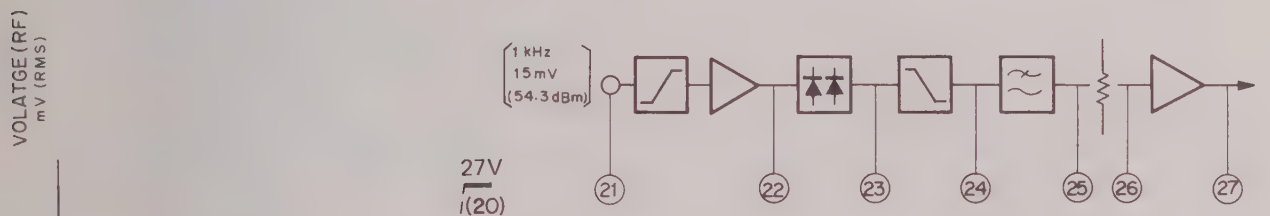


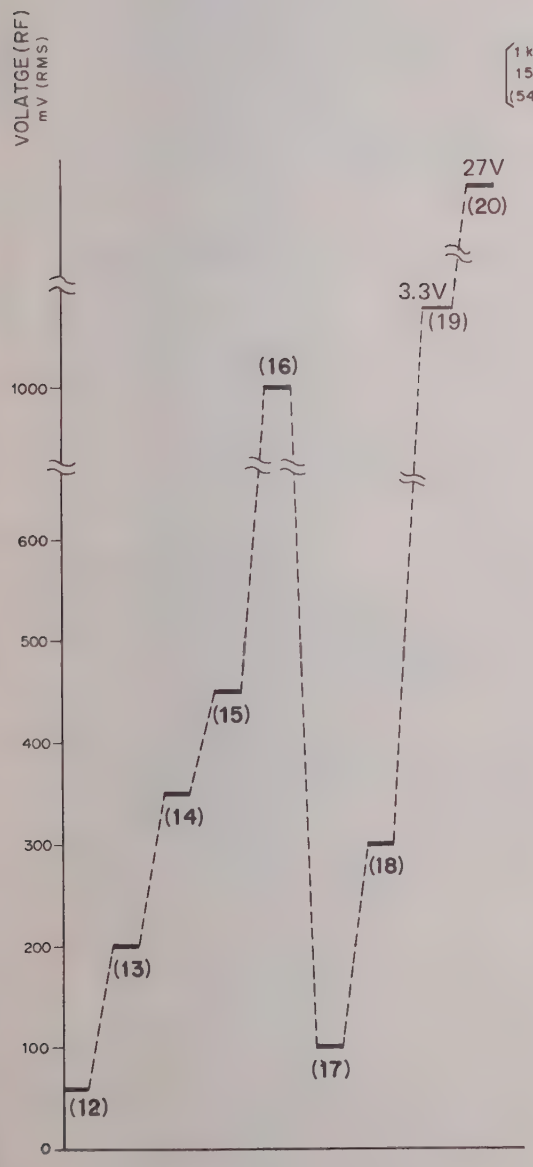


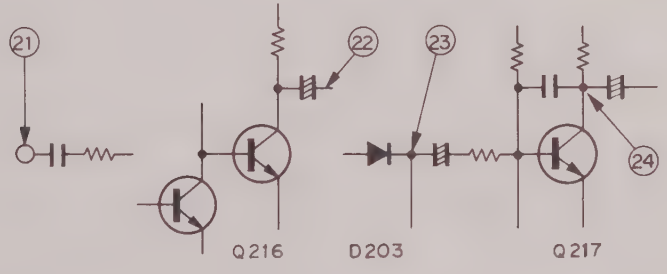
LEVEL DIAGRAM (TRANSMITTER SECTION)

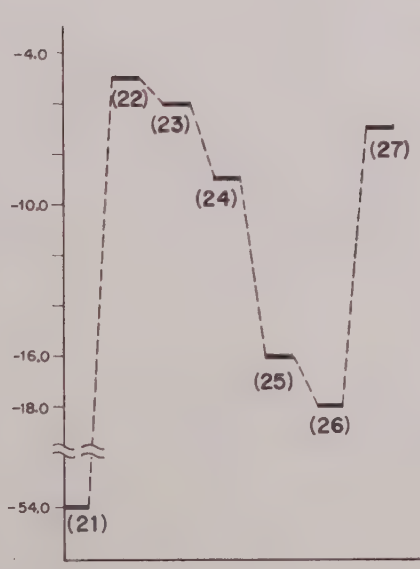


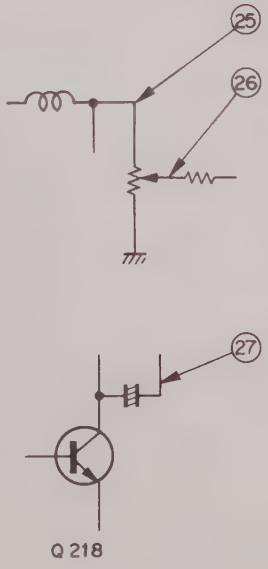


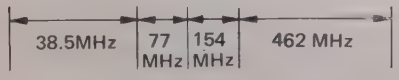












VOLTAGE CHART

(DC VOLTS)

	B G	C D	E S			B	C	E	
Q_{101}	1.3 2.9 V	7.0 V	1.0 V	G G	Q_{203}	0.9 V	6.9 V	0.1 V	
Q_{102}	1.2 1.7	6.0	0.5	G G	Q_{204}	0.7	8.0	0	
Q_{103}	2.2	7.1	1.5		Q_{205}	0.5	8.1	0	
Q_{104}	0.4	5.5	0		Q_{206}	0	8.2	0	
Q_{105}	0.3	3.4	0		Q_{207}	0.6	8.1	0	
Q_{106}	1.2	7.3	0.5		Q_{208}	0.3	13.6	0	
Q_{107}	2.7	7.9	2.2		Q_{209}	0.4/0.4	8.1/8.1	1.5/1.0	APC OPEN 10W
Q_{108}	1.4	7.3	0.7		Q_{210}	4.5	8.1	3.8	
Q_{109}	0.7	2.3	0		Q_{211}	12.9/12.4	12.6/9.1	12.0/13.1	APC: OPEN 10W
Q_{110}	4.7	6.3	4.4		Q_{212}	0.8/0.7	0.1/10.1	0	"
Q_{113}	0.7	2.1	0		Q_{213}	1.0	5.0	0.3	
Q_{114}	2.1	3.6	1.4		Q_{214}	0 0.8	8.1 5.7	0	RX TX
Q_{115}	0.8 1.1	0.3 1.8	0.1 0.5	SQ OFF ON					
Q_{116}	0.1 1.2	13.4 0.7	0.1 0.5	"					
Q_{117}	0.7 0.5	0.8 6.8	0	"					
Q_{201}	2.2	7.6	1.5						
Q_{202}	1.1	7.6	0.3						

PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Q_{101}	5.2	1.6	1.7	0	6.8	2.7	8.2	—	—	-	—				
Q_{102}	5.4*	0	1.5*	6.7*	10.4*	5.4*	0	5.5*	5.3*	13.2*	13.6	-		-	* SQ ON L Level
Q_{103}	—	13.0*	13.0*	13.6*	—	—		-	—					-	* Nominal Value
Q_{104}	—	0	0	5.2 5.1	5.1 0.8	3.7 0.8	4.9 0.7	—	0	0	0	3.8 1.6	3.4 1.6	5.0 0.8	APC: OPEN 10W
Q_{115}	0.5	0.5	0.5	3.2	4.0	0.5	0	0.5	2.3	3.3	0.5	0.5	0.5	8.2	
Q_{116}	5.2	13.6	5.2	0	1.9 0	5.2 0	—	0 5.2	—	—	—	—	—	—	RX TX

Measured with VTVM.

CIRCUIT/DEVICE INFORMATION

1. **Input final RF device: Q_{209} (M57704H)**

Pin	DC volts	DC current
1	0	
2	* 13.0	0.98A
3	* 13.0	
4	13.8	1.56A
5	0	

* Nominal Value

2. **Spurious reduction at antenna jack**

Spurious radiation from the antenna terminal is suppressed by: (1) a low-pass filter, consisting of L_{216}, C_{289}, C_{246}, L_{217}, C_{247}, C_{248}, C_{249}, L_{218}, C_{250} and C_{306} in a pi configuration for harmonic reduction of better than 60 dB: (2) T_{206}, C_{222}, T_{207}, C_{224}, C_{225}, C_{226}, T_{208}, C_{227}, C_{230}, T_{209}, C_{231}, C_{232}, L_{205}, C_{244}, TC_{202}, C_{237}, L_{207}, TC_{203}, and C_{238}, which attenuate nonharmonic spurious more than 60 dB.

Spurious radiation from the case, power cable, etc.

The following capacitors ensure maximum attenuation of spurious signals from the case, power cable, and other areas: C_{216}, C_{220}, C_{229}, C_{234}, C_{235}, C_{240}, C_{241}, C_{242}, C_{243}, C_{141}, C_{142}, C_{148}, and C_{159}. Coils are sealed where they could cause spurious radiation.

Deviation circuit

The Instantaneous Deviation Control Circuit (IDC) consists of D_{202}, D_{203}, R_{251}, R_{252}, and R_{253}, which control the deviation level.

Power control circuitry

The Automatic Power Control (APC) circuitry consists of Q_{210}, Q_{211}, R_{275}, VR_{202}, Q_{212}(d) (b), Q_{214}, and Q_{213}. VR_{202} provides precise setting of the output power.

Audio filtering

An audio filter, consisting of R_{254}–R_{257}, and C_{256}–C_{258}, provides attenuation of audio frequencies above 3 kHz of –18 dB/octave referenced to 1 kHz. The filter is of the active-filter type.

3. **Frequency stability/adjustment/channel selection**

Diode switches D_{204}, D_{205} select crystals X_{201}, X_{202}, thus providing for channel selection.

The oscillator acts in the third overtone mode, and the tuned circuits at the emitter of Q_{201} ensure minimum spurious radiation. Feedback capacitors C_{203} and C_{204} provide temperature compensation, and parts chosen for this position have an N value of at least 750.

Frequency adjustment is provided by T_{210}, T_{211}, connected in series with the channel crystals.

Temperature compensation is chiefly provided by thermistors TH_{201} and TH_{202} plus resistors R_{292}, R_{293}, and R_{294}, which provide a variable voltage in proportion to temperature change, the control voltage driving varicap diode D_{206} (FC52M) to keep the channel frequency to within 5 ppm over the temperature range –30° to +60°C. This specification will be held so long as crystals made to our specifications (+8 to 0 ppm at –20°C ref. 25°C, AT cut, 3rd overtone) are used.

The supply voltage for the oscillator is stabilized by Q_{401}, which decreases voltage change caused by variations in temperature.

SOLDERING AND DESOLDERING TECHNIQUE ON PRINTED CIRCUIT BOARDS

The FTC-5010 circuit boards are tough, but mishandling during soldering can cause circuit traces to "lift." While this does no permanent damage to the board, much servicing trouble can result, because of the tendency for this lifted trace to break. A few simple precautions will keep your circuit boards in A-1 condition.

1. Use only a 12 to 30 watt chisel-tip soldering iron. Yes, some "repairmen" have been known to use small blowtorches on cards.

2. Use only a soldering iron equipped with a three-wire cord, with the tip grounded. Also acceptable is a soldering iron isolated through a transformer. An old soldering iron or gun may have 117 volts on the tip, and will certainly cause more damage than it repairs!

3. USE ONLY 60/40 ROSIN CORE SOLDER. Acid core solder should be thrown away if you find it in your radio shop!

4. Use a solder sucker and solder tape to ensure a professional repair job.

5. If you do lift a trace, don't worry! Read on to find out how to repair traces like a pro.

NOTES ON USE OF CMOS COMPONENTS:

As CMOS devices are extremely sensitive to damage from static electricity, special precautions must be observed.

In storage, use only a non-inductive sponge.

When installing a CMOS part in a socket, or on a circuit board, be certain that the power is off. In addition, the technician should rest his hand on the chassis as the component is inserted, so as to place his hand at the same level as the chassis (better to discharge small amounts of static electricity through your fingers than through a $5 IC !).

When soldering a CMOS part onto a circuit board, use a low wattage iron, and be sure to ground the tip with a clip lead, if the tip is not grounded through a three-wire power cord.

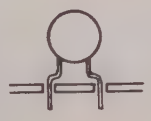
INSERTION OF PARTS ON CIRCUIT BOARDS

All of the below are acceptable ways of inserting components into circuit board mounting holes.

(a) Bend leads slightly

(b) Straight-in mounting

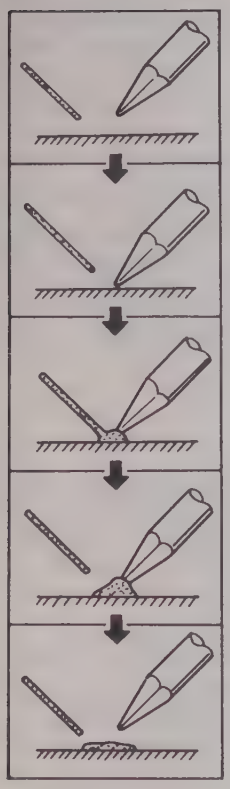
(c) Vertical mounting



(d) Preformed disc ceramic capacitor

(e) Preformed resistor, diode, etc.

BASIC SOLDERING PRACTICE



(1) Prepare soldering iron and solder.

(2) Apply soldering iron to surface to be soldered.

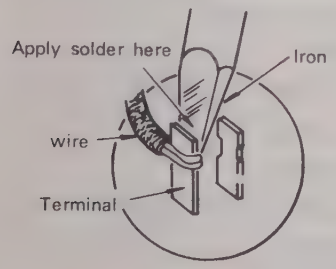
(3) Apply solder to heated surface.

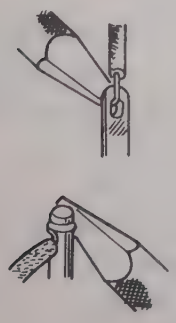
(4) When enough solder is applied, remove solder. Continue to apply heat until solder flows cleanly.

(5) Remove iron from work. Do not apply more heat than necessary for good solder flow.

Soldering to terminal posts:

(Be certain to apply heat to both post and wire.)

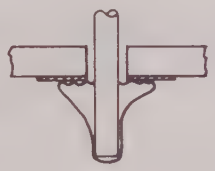




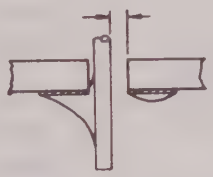
EXAMPLES OF POOR SOLDERING PRACTICE

Solder bridge (caused by use of too much solder)

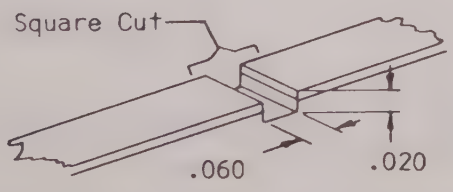
"Cold joint" (caused by insufficient heat to part of work, resulting in poor solder flow)



Unstable joint (caused by insufficient heat or solder)



If you have previously lifted a trace, make an etch cut on each side of the lifted trace, and install a wire bridge as shown in the drawing.



Coat Cut Area With Eastman 910

FAULT LOCALIZATION

While the process of fault localization is highly individualistic, it is generally agreed that there is no substitute for a logical, step-by-step diagnostic check.

Begin your troubleshooting procedure with a visual inspection of the radio. Use your nose, too: burned resistors smell differently than do transformers, etc. Check for charred or loose components inside the cabinet.

If the preliminary inspection turns up nothing, connect a dummy load to the antenna jack, and a 13.8 VDC bench supply to the power cord. The supply should be capable 4 amperes continuous for the FTC-5010.

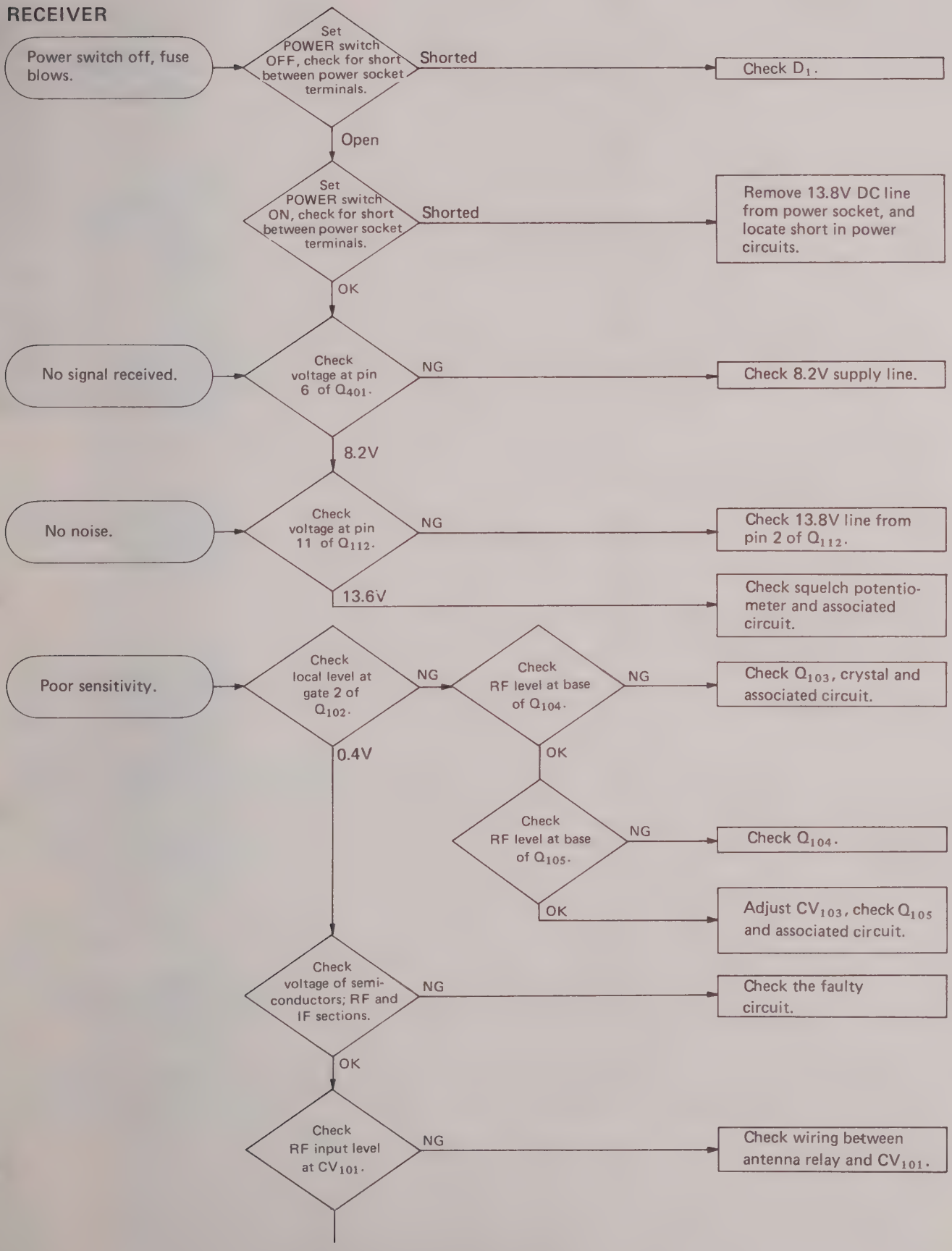
Turn the power switch on, and begin a systematic check. Do the lamps light up? If not, check the fuse. Is the trouble not apparent? Perhaps it only happens on transmit. Check for noises, pops, sparks, or smoke inside the cabinet — these are unmistakable declarations by the radio that something is awry!

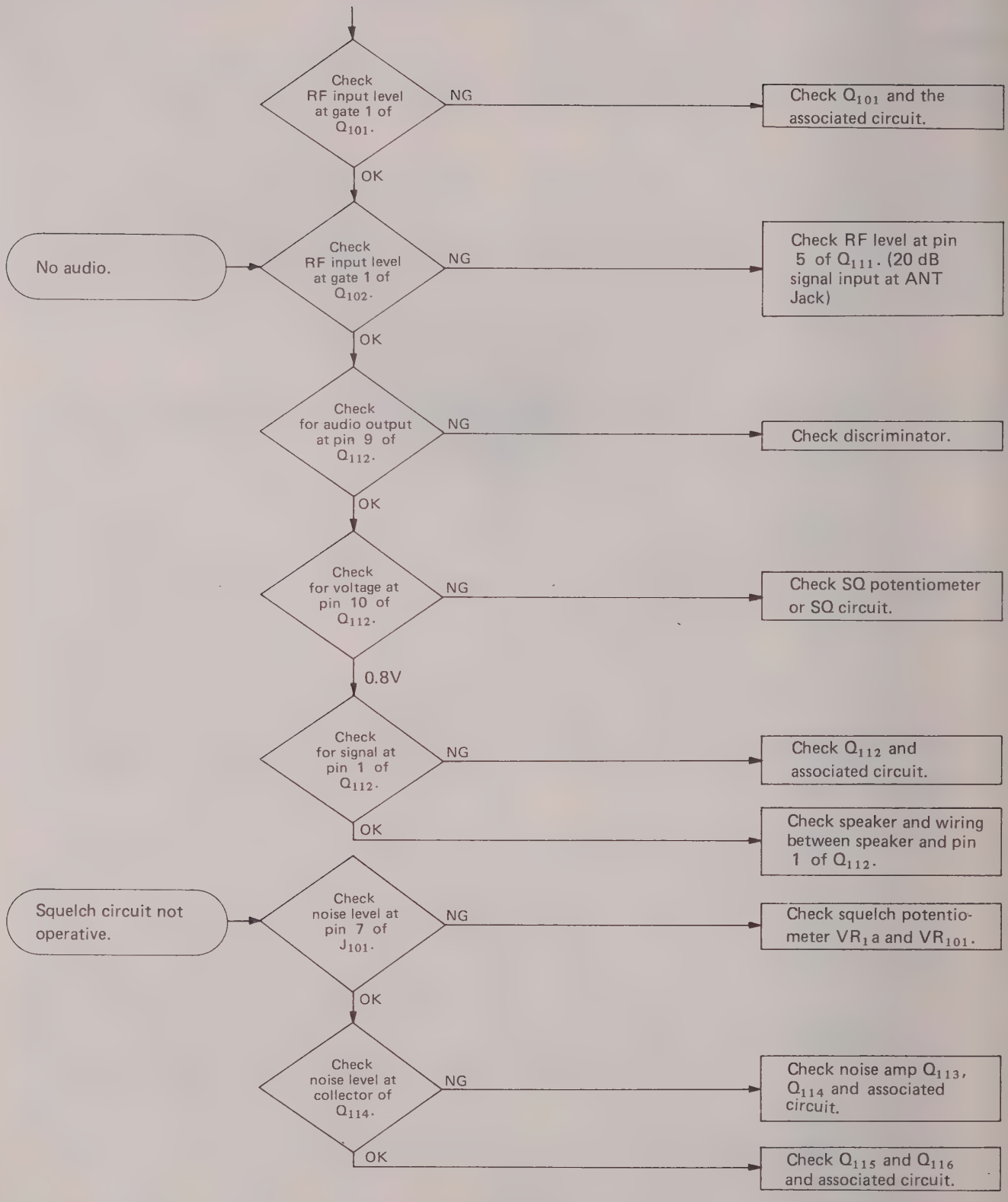
TYPICAL PART FAILURES, CAUSES, AND SYMPTOMS

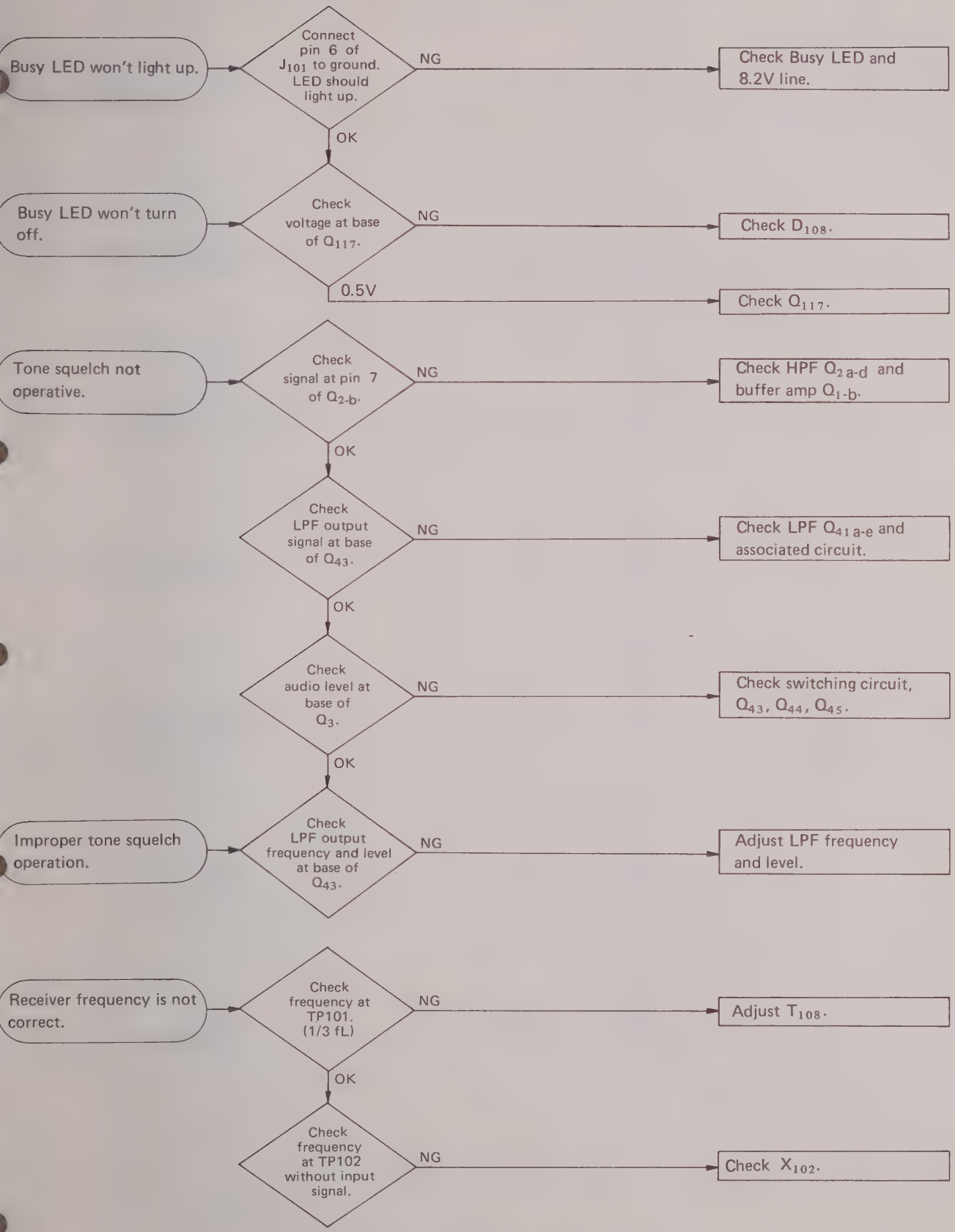
PARTS	CAUSE OF TROUBLE	SYMPTOMS
Semiconductors (IC, FET, TR)	High supply voltage Open circuit Excessive drive High temperature	Short or open circuit Output decreases to 1/2 at 80°C Internal noise Instability
MOS FET MOS IC	Static electricity	Total failure
Crystal Crystal filter	Shock High temperature	Crystal destroyed Frequency drift Filter bandpass change
Resistor	Excessive power Aging High temperature	Component burned Value changed Open circuit
Potentiometer	Excessive power Shock	Component burned Open circuit Noise Unsmooth rotation
Capacitor	Excess voltage High temperature Excess power	Shorted Leakage Open/decreased capacitance
Variable capacitor Trimmer capacitor	Ratings exceeded Dust between plates Shock, forced rotation	Shorted Leakage Unsmooth rotation
Coils	Ratings exceeded Variation	Open or short circuit Leakage or shorted turns Detuned
Switch	Ratings exceeded Aging	Poor contact Unsmooth operation Open circuit
Relay	Ratings exceeded Humidity	Poor contact Noise Coil open

TROUBLESHOOTING

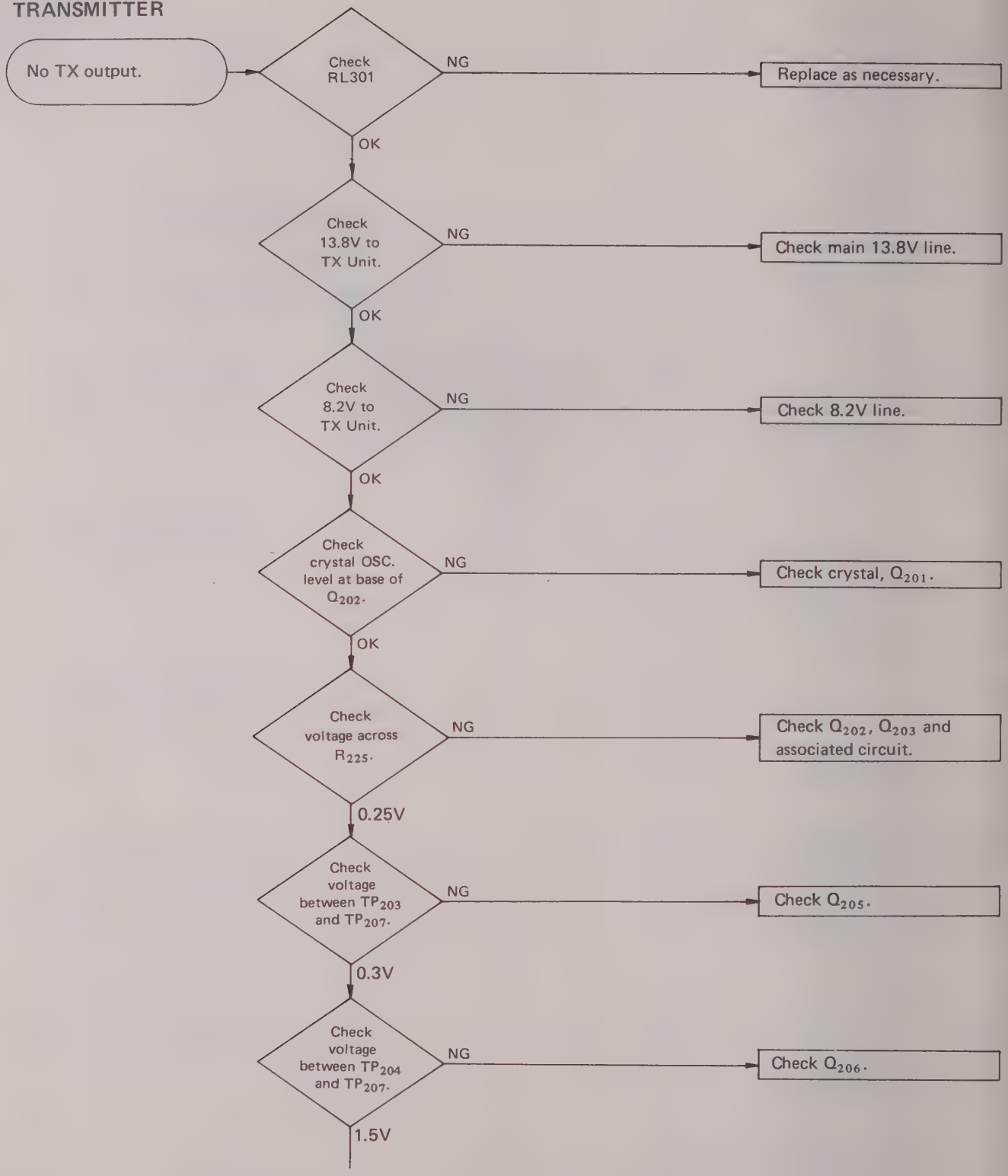
RECEIVER

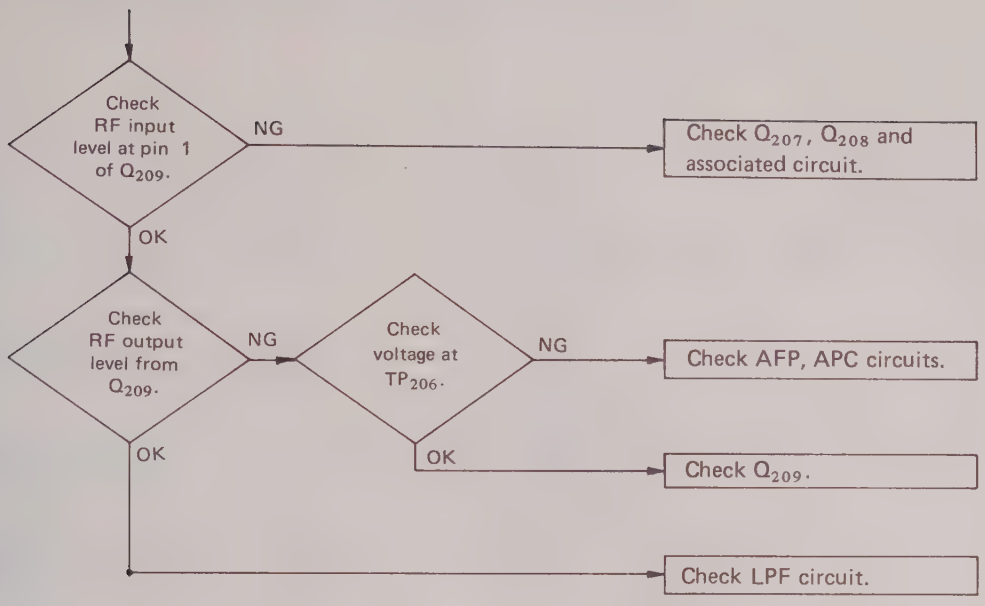

Power switch off, fuse blows.
Set POWER switch OFF, check for short between power socket terminals.
Shorted
Check D_1.
Open
Set POWER switch ON, check for short between power socket terminals.
Shorted
Remove 13.8V DC line from power socket, and locate short in power circuits.
OK
No signal received.
Check voltage at pin 6 of Q_{401}.
NG
Check 8.2V supply line.
8.2V
No noise.
Check voltage at pin 11 of Q_{112}.
NG
Check 13.8V line from pin 2 of Q_{112}.
13.6V
Check squelch potentiometer and associated circuit.
Poor sensitivity.
Check local level at gate 2 of Q_{102}.
NG
Check RF level at base of Q_{104}.
NG
Check Q_{103}, crystal and associated circuit.
0.4V
OK
Check RF level at base of Q_{105}.
NG
Check Q_{104}.
OK
Adjust CV_{103}, check Q_{105} and associated circuit.
Check voltage of semiconductors; RF and IF sections.
NG
Check the faulty circuit.
OK
Check RF input level at CV_{101}.
NG
Check wiring between antenna relay and CV_{101}.

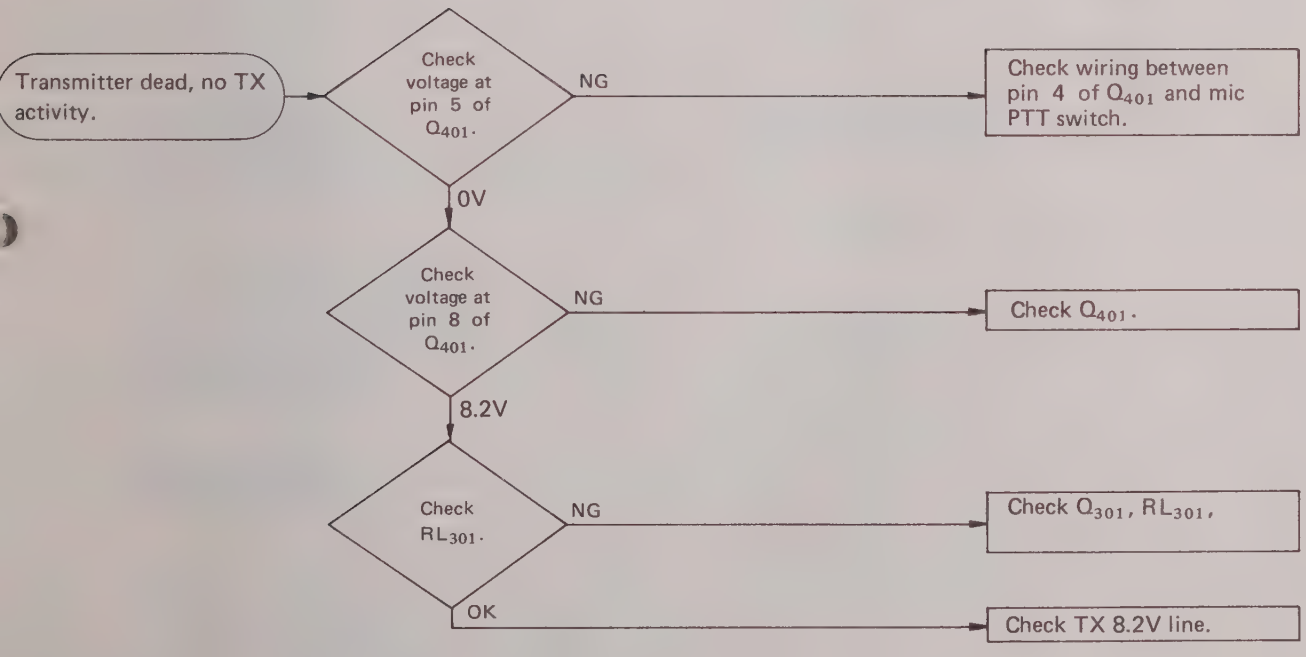

Check RF input level at gate 1 of Q_{101}.
NG
Check Q_{101} and the associated circuit.
OK
No audio.
Check RF input level at gate 1 of Q_{102}.
NG
Check RF level at pin 5 of Q_{111}. (20 dB signal input at ANT Jack)
OK
Check for audio output at pin 9 of Q_{112}.
NG
Check discriminator.
OK
Check for voltage at pin 10 of Q_{112}.
NG
Check SQ potentiometer or SQ circuit.
0.8V
Check for signal at pin 1 of Q_{112}.
NG
Check Q_{112} and associated circuit.
OK
Check speaker and wiring between speaker and pin 1 of Q_{112}.
Squelch circuit not operative.
Check noise level at pin 7 of J_{101}.
NG
Check squelch potentiometer VR_1a and VR_{101}.
OK
Check noise level at collector of Q_{114}.
NG
Check noise amp Q_{113}, Q_{114} and associated circuit.
OK
Check Q_{115} and Q_{116} and associated circuit.

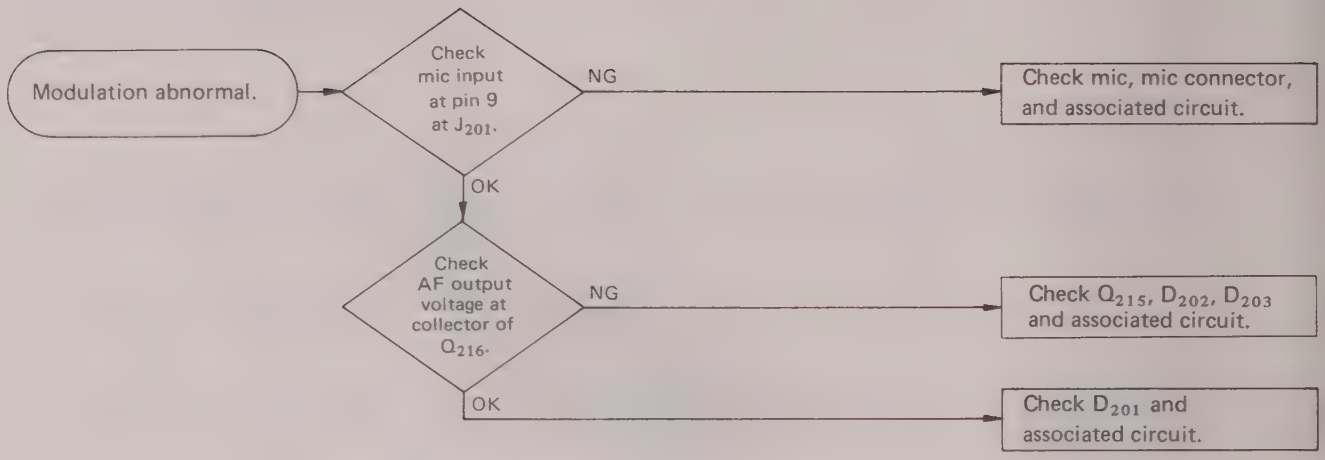

Busy LED won't light up.
Connect pin 6 of J_{101} to ground. LED should light up.
NG
Check Busy LED and 8.2V line.
OK
Busy LED won't turn off.
Check voltage at base of Q_{117}.
NG
Check D_{108}.
0.5V
Check Q_{117}.
Tone squelch not operative.
Check signal at pin 7 of $Q_{2\text{-}b}$.
NG
Check HPF $Q_{2\,a\text{-}d}$ and buffer amp $Q_{1\text{-}b}$.
OK
Check LPF output signal at base of Q_{43}.
NG
Check LPF $Q_{41\,a\text{-}e}$ and associated circuit.
OK
Check audio level at base of Q_3.
NG
Check switching circuit, Q_{43}, Q_{44}, Q_{45}.
OK
Improper tone squelch operation.
Check LPF output frequency and level at base of Q_{43}.
NG
Adjust LPF frequency and level.
Receiver frequency is not correct.
Check frequency at TP101. (1/3 fL)
NG
Adjust T_{108}.
OK
Check frequency at TP102 without input signal.
NG
Check X_{102}.

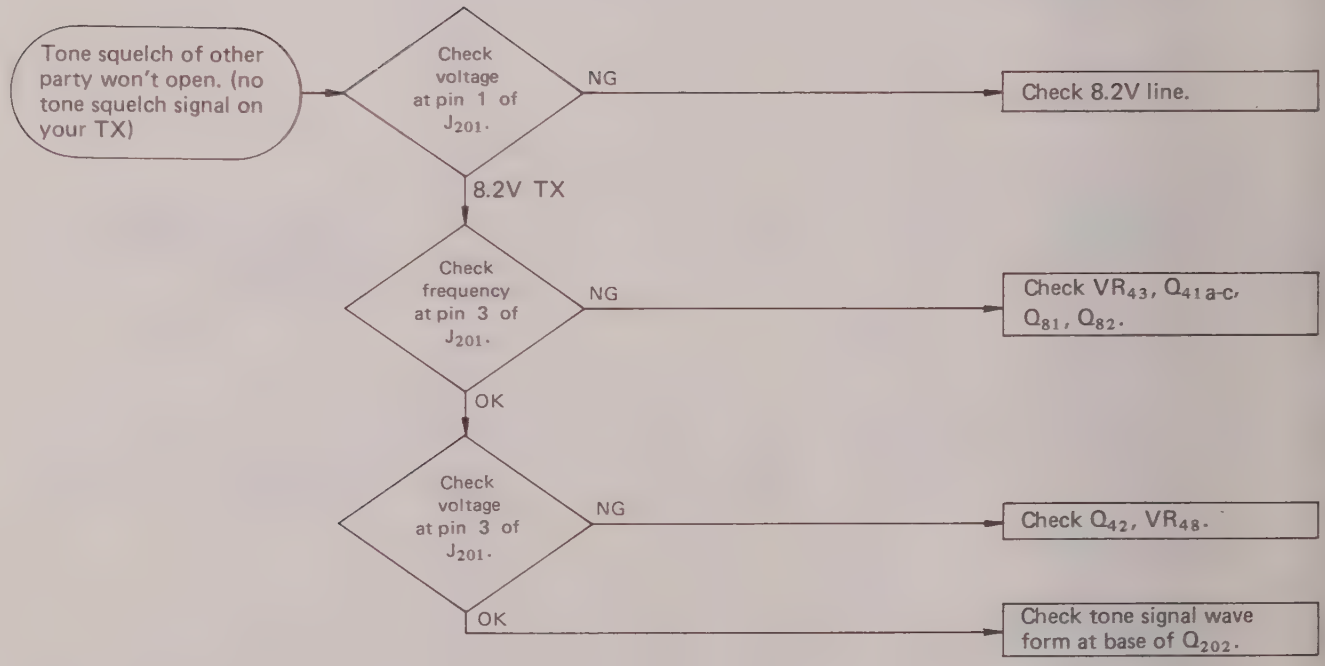
TRANSMITTER




Check RF input level at pin 1 of Q_{209}.
NG
Check Q_{207}, Q_{208} and associated circuit.
OK
Check RF output level from Q_{209}.
NG
Check voltage at TP_{206}.
NG
Check AFP, APC circuits.
OK
OK
Check Q_{209}.
Check LPF circuit.


Transmitter dead, no TX activity.
Check voltage at pin 5 of Q_{401}.
NG
Check wiring between pin 4 of Q_{401} and mic PTT switch.
0V
Check voltage at pin 8 of Q_{401}.
NG
Check Q_{401}.
8.2V
Check RL_{301}.
NG
Check Q_{301}, RL_{301},
OK
Check TX 8.2V line.


Modulation abnormal.
Check mic input at pin 9 at J_{201}.
NG
Check mic, mic connector, and associated circuit.
OK
Check AF output voltage at collector of Q_{216}.
NG
Check Q_{215}, D_{202}, D_{203} and associated circuit.
OK
Check D_{201} and associated circuit.


Tone squelch of other party won't open. (no tone squelch signal on your TX)
Check voltage at pin 1 of J_{201}.
NG
Check 8.2V line.
8.2V TX
Check frequency at pin 3 of J_{201}.
NG
Check VR_{43}, Q_{41}a-c, Q_{81}, Q_{82}.
OK
Check voltage at pin 3 of J_{201}.
NG
Check Q_{42}, VR_{48}.
OK
Check tone signal wave form at base of Q_{202}.

MAINTENANCE AND SERVICING

REGULAR MAINTENANCE PLAN

Because of the rugged design and construction of the FTC-5010, little maintenance should be required if the radio is not abused. As a Yaesu dealer, though, you are best in a position to determine the individual needs of your customers. Operation in extremely harsh environments may warrant more frequent checks of transceiver performance.

We recommend that your customers return their sets to your service facility once every two years for routine checks of the transmitter power output and the receiver sensitivity. In the meantime, keep in frequent touch with your customers regarding their expanding communications requirements. Not only will this give you the opportunity to introduce new Yaesu products, but your customers' particular service requirements will become evident.

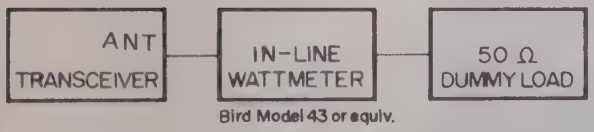
PERFORMANCE CHECKS

Make all performance checks at 13.8 volts DC under load.

Check the transmitter power output as follows:

a) Connect a suitable dummy load/wattmeter to the antenna jack.

b) Set the REPEAT/DIRECT switch to any position. Close the push-to-talk switch, and observe the power output. The output should be at least 10 watts.



PO TEST SETUP

Check the receiver sensitivity as follows:

a) Connect an audio voltmeter to the SP jack, and set the squelch control fully counter-clockwise.

b) Connect the RF output of a precision UHF signal generator to the antenna jack, and note the audio voltmeter reading with no signal present. Adjust the volume control and voltmeter range, as necessary, to obtain roughly a full-scale reading.

c) Set the signal generator to the receiving frequency of the radio, and adjust the output amplitude of the signal generator until the voltmeter indicates a 20 dB decrease (1/10th voltage) of the reading in step b. The signal generator output voltage at this point is the 20 dB quieting sensitivity, and it should be approximately 0.5 μV.

RX SENSITIVITY TEST SETUP

If the above checks are both OK, then clean out the transceiver by applying moderate-force compressed air throughout the chassis area. This will remove any dust that may be present. If there is accumulated dirt inside the cabinet, a soft brush may be used to loosen it. Wipe the outer cabinet of the transceiver with a damp cloth, and use the compressed air to dislodge accumulated dust present in the corners of the radio.

ALIGNMENTS

PRELIMINARY ADJUSTMENTS

Internal adjustments should, undermost circumstance, be limited to those described in the paragraphs below.

Remove the four screws from the top cover. Then the four screws from the bottom cover, in order to provide full access to the transceiver circuitry.

NOTE:

Use nonmetallic tuning wands to adjust trimmer capacitors and coils.

Equipment needed:

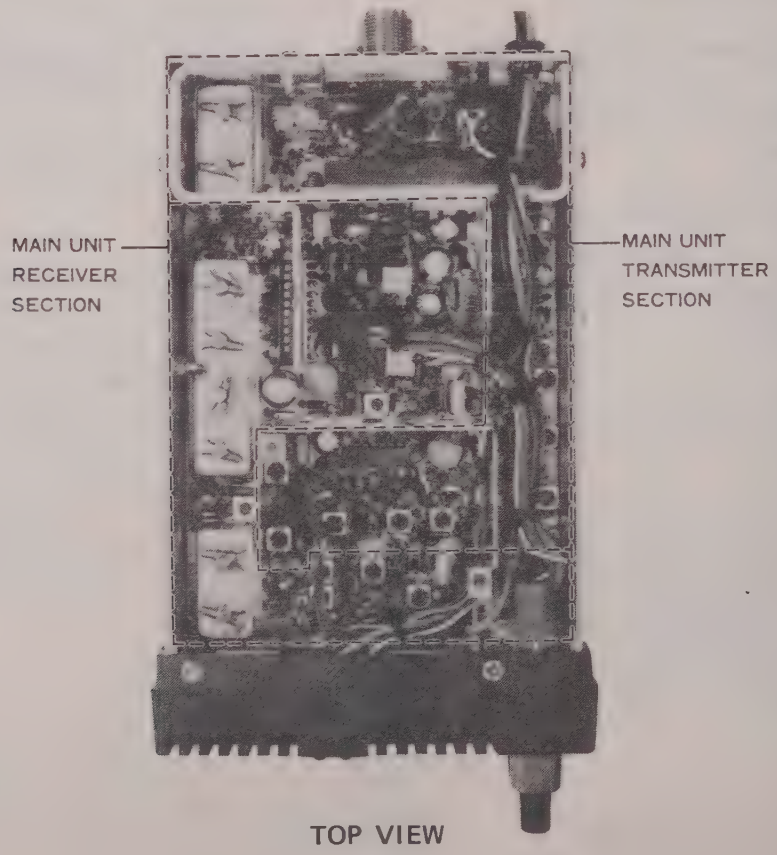
1. Precision UHF signal generator.
2. Precision UHF frequency counter.
3. Sweep generator (cover upto 500MHz).
4. Alignment scope.
5. Audio Voltmeter.
6. DC voltmeter.
7. Vacuum-tube voltmeter, 20Kohms/volt, useable upto 500MHz.
8. Bench power supply.
9. Alignment tools.
10. Interconnection cables.

Alignment steps:

I Receiver
- 1-1) Second IF
- 1-2) Second local
- 1-3) First IF
- 1-4) First local
- 1-5) RF section
- 1-6) Sensitivity peaking
- 1-7) Squelch sensitivity

II Transmitter
- 2-1) Oscillator
- 2-2) Multiplier stages
- 2-3) Bandpass filter
- 2-4) Spurious reduction
- 2-5) Deviation setting
- 2-6) RF power output
- 2-7) AFP circuit

III Tone Squelch
- 3-1) Encoder output level adjustment
- 3-2) Decoder input level adjustment
- 3-3) Tone frequency adjustment



TOP VIEW

ALIGNMENT: RECEIVER

1-1) Second IF

Connect a 455 kHz sweep generator to TP_{102} and connect an XY scope (vertical amp. input) to pin 5 of J_{101}. Adjust T_{107} for maximum p-p indication on the scope.

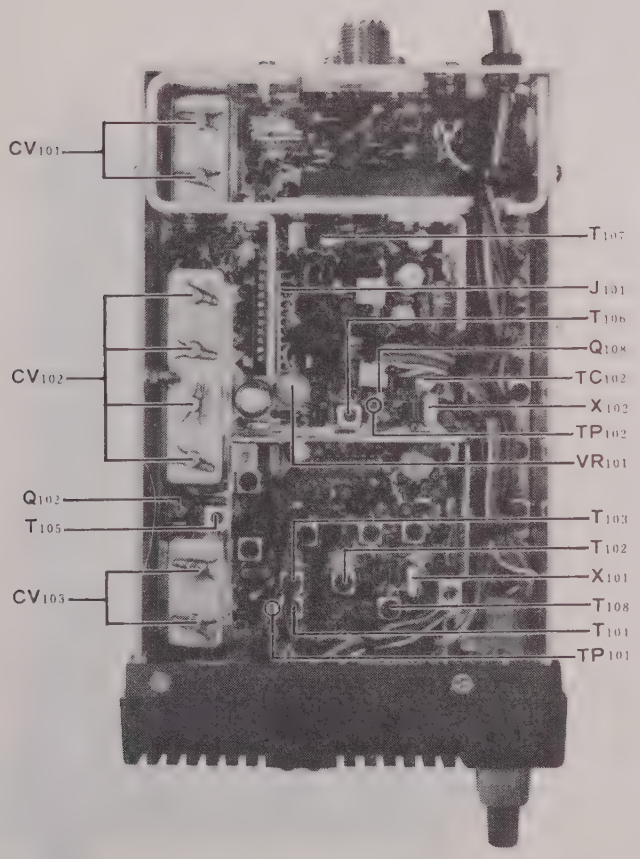
1-2) Second Local

Connect a precision frequency counter, through a 20 pF capacitor, to the collector of Q_{108}. Adjust TC_{102} for a reading of exactly 20.945 MHz on the counter.

1-3) First Local

Connect the RF probe of a VTVM to TP_{101}. Adjust T_{103} and T_{104} for maximum indication on the VTVM.

Connect the RF probe of a VTVM to gate 2 of Q_{102}. Adjust CV_{103} for maximum indication on the VTVM.



RECEIVER SECTION ALIGNMENT POINTS

Connect a precision frequency counter to TP_{101} (through an 0.01 μF capacitor). Preset the core of T_{102} to be flush with the top of the shield can. Now adjust T_{108} for the following frequency:

$$f_{test} = \frac{f\ (RX\ channel) - 21.4\ MHz}{3}$$

1-4) RF Section

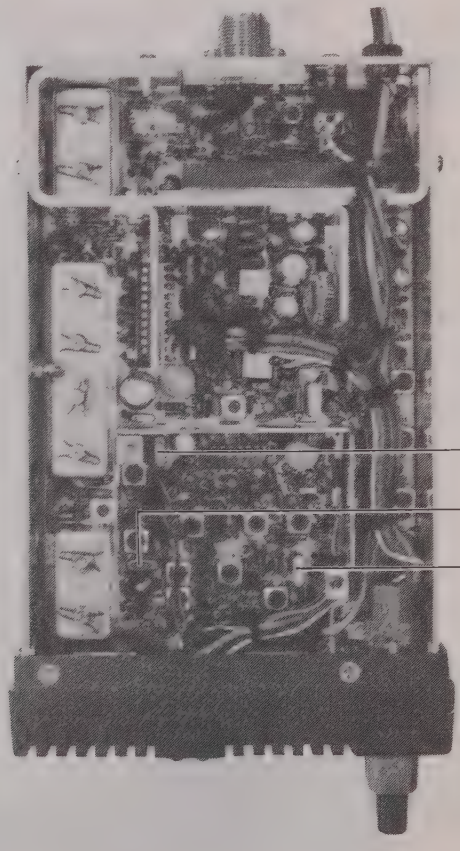
Connect a precision UHF signal generator to the antenna jack, and connect an AF millivoltmeter to the speaker jack (use 8 ohm termination). Inject a signal on the channel frequency at a level providing about 10 dB of noise quieting. Now adjust CV_{101}-CV_{103} for maximum noise quieting as shown on the meter. Adjust the signal generator level, and meter scale, as needed, to provide a meaningful display.

1-5) SINAD Sensitivity

Connect a signal generator set to the channel frequency, with 1 kHz mod. @ ±3 kHz deviation to the ANT jack. Connect an audio distortion meter to the speaker jack, using an 8 ohm termination. Inject a signal from the generator so that the distortion meter indicates 25% distortion. Adjust T_{105} and T_{106} for minimum distortion. Now reset the signal generator level for 25% distortion, and again adjust T_{105} and T_{106} for minimum distortion. Repeat several times.

1-6) Squelch Adjustment

Connect a signal generator to the ANT receptacle, set the deviation to 60% at 1 kHz, and adjust the frequency to the desired channel frequency. Set the output to 0.2μV. Rotate the SQL knob on the front panel to the 270 degree position, then adjust VR_{101} just to the position where the squelch opens.



CRYSTAL LOCATIONS

ALIGNMENT: TRANSMITTER

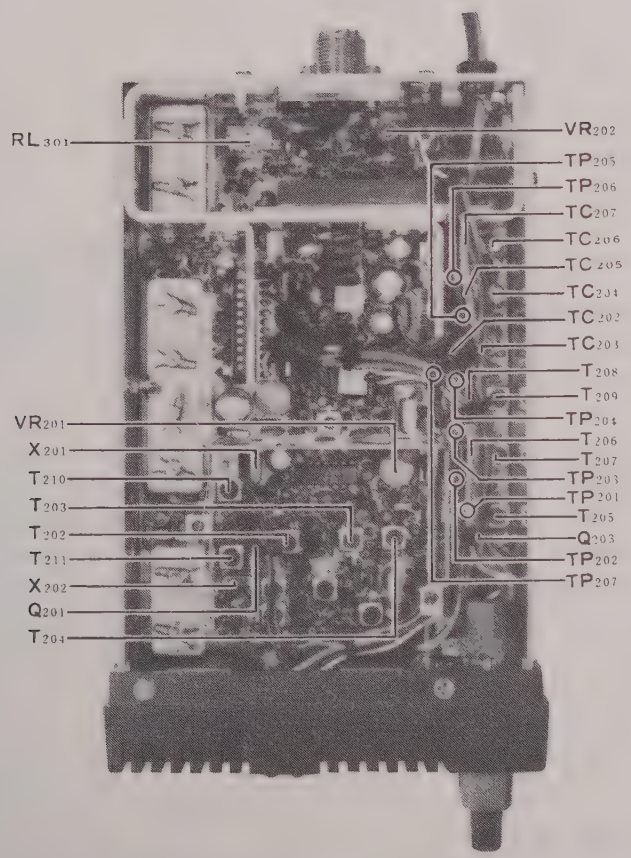
2-1) Oscillator Circuit

Connect a dummy load/UHF wattmeter to the antenna jack. Connect the RF probe of a VTVM to the base of Q_{203}. Close the PTT switch, and adjust T_{203} for maximum deflection on the VTVM. Now connect a frequency counter to the base of Q_{203}, and preset the core of T_{202} to be flush with the top of the shield can. Then, adjust T_{210} in the REPEATER mode, and T_{211} in the DIRECT mode, for exactly the following frequency:

$$f_{test} = \frac{f\ (\text{transmit channel})}{12}\ \text{MHz}$$

2-2) Multiplier Stages

Leave the dummy load/wattmeter connected to the antenna jack. Turn VR_{202} fully clockwise. Now connect a DC voltmeter between TP_{202} and TP_{207}. Adjust T_{205} and T_{206} for maximum indication on the voltmeter. Now connect the meter to TP_{203}, and adjust T_{207} and T_{208} for maximum indication on the meter. Connect the meter to TP_{204}, and adjust T_{209} for maximum deflection. Connect the meter to TP_{205}, and adjust TC_{202} and TC_{203} for maximum deflection on the meter. Connect the meter to TP_{206}, and adjust TC_{204} and TC_{205} for maximum deflection on the meter.



TRANSMITTER SECTION ALIGNMENT POINTS

2-3) Bandpass Filter Adjustment

Assemble the test equipment as shown in Figure 5. Adjust $T_{206}-T_{209}$ and $TC_{202}-TC_{207}$ so that the display shown in Figure 6 is obtained. Several passes through the alignment procedure may be necessary to achieve the proper bandpass.

2-4) Spurious Reduction

Connect a 6 dB hybrid combiner to the antenna jack. Connect a dummy load/wattmeter and a spectrum analyzer to the hybrid. Adjust TC_{203} for minimum spurious emission over the range 1/3 f_t to 4/3 f_t (f_t = TX frequency. Now adjust TC_{207} for minimum spurious signals over the range 10/12 f_t to 14/12 f_t.

Recheck the bandpass filter tuning after adjustment of TC_{207}.

2-5) Deviation Setting

Assemble the test equipment as shown in Figure 7. Inject a 1 kHz signal of 5.5 mV at the mic jack. Adjust VR_{201} for a deviation of ±4.9 kHz. Now reduce the AF generator level, so that the deviation reaches ±3 kHz. Adjust T_{203} and T_{204} for minimum distortion. If the deviation changes during this alignment, adjust it again. Several passes may be necessary.

2-6) RF Power Adjustment

With the dummy load/wattmeter connected to the antenna jack, adjust VR_{202} for 10 watts RF output.

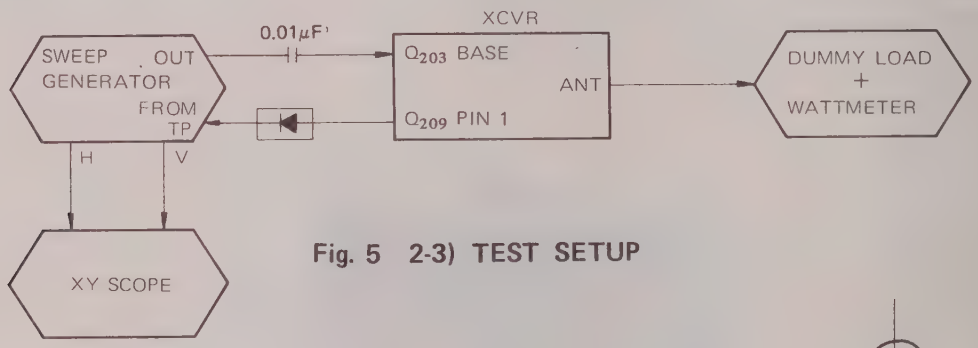
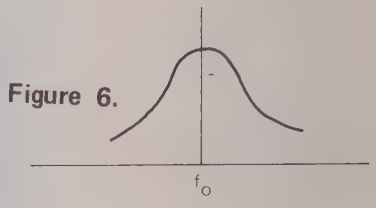


Fig. 5 2-3) TEST SETUP



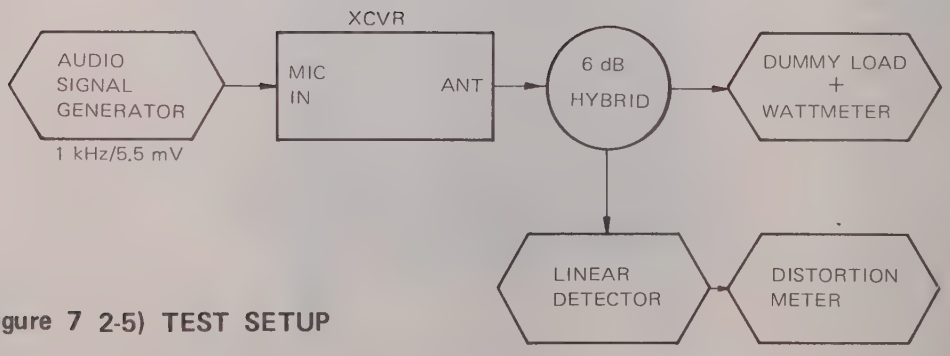


Figure 7 2-5) TEST SETUP

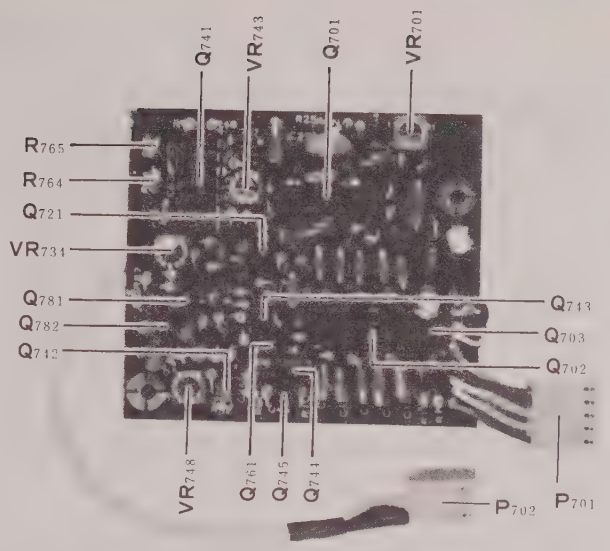
ALIGNMENT; TONE SQUELCH

3-1) Encoder Output Level Adjustment

Assemble the test equipment as shown in Figure 8.

Adjust VR_{748} for deviation of ±0.5 kHz without any mic input signal. Connect audio generator to the mic jack, then apply a 5.5 mV 1 kHz signal.

If the maximum deviation is other than ±4.9 kHz, readjust VR_{201}.



TONE SQUELCH UNIT ALIGNMENT POINTS

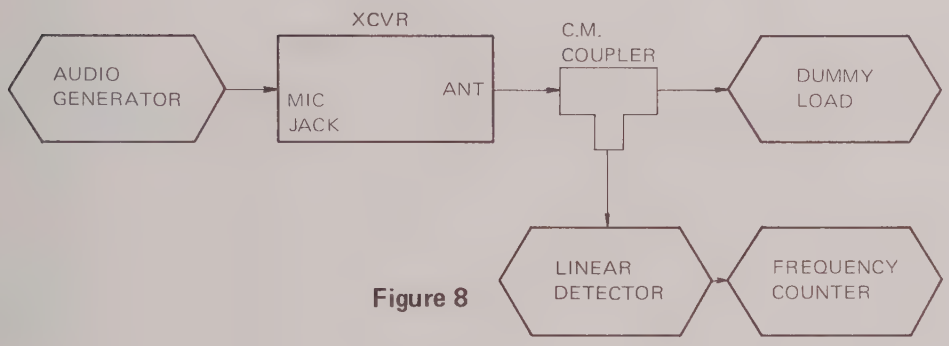


Figure 8

3-2) Decoder Input Level Adjustment

Assemble the test equipments as shown in Figure 9.

Set the output of the signal generator to 30 dBμ with modulation of 1 kHz, ±0.5 kHz deviation. Connect the level meter to pin 7 of Q_{701}. Adjust VR_{701} for an output level of 10 mV.

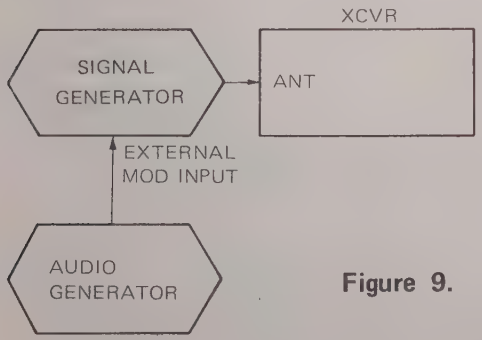


Figure 9.

3-3) Tone Frequency Adjustment

When the tone frequency needs to be changed, Replace R_{764}, R_{765} according to Table 1.

You need not to readjust VR_{743} as long as 0.5% tolerance resistors are used.

When the tone frequency is changed, the tone squelch activating point must be adjusted as follows.

Connect the signal generator to the antenna jack and set the output of the signal generator for 30 dBμ, ±0.5 kHz deviation.

Reduce the audio input level by 9 dB at the external mod. terminal of the signal generator. Adjust VR_{734} to the point where the tone squelch just opens.

MEMO

PARTS LIST AND ORDERING DATA

If you live in the United States, you may order parts from Yaesu Electronics Corporation. In other countries, you should order parts from the Yaesu agent for your country. In countries where Yaesu is not currently represented, you may order spare parts directly from Yaesu Musen Company, Ltd. in Tokyo.

When ordering, please specify the exact model number of the transceiver that the part is for. Many parts are standard, such as resistors and disc ceramic capacitors, but you should use particular care when ordering such items as electrolytics, tantalum capacitors, and the like.

The parts list to follow identifies the board that the parts belong to, as well as the circuit designation and part description. A "Part Number" is also specified, and this number will allow immediate identification by our parts department of the item you require.

Shipment of parts from Yaesu USA is usually made by UPS, COD. Allow at least a week for the parts department to process your order. You will receive prompt notification that your order has been received, and if parts are back ordered, or if additional information is required, you will be so informed.

PARTS ORDER EXAMPLE

QUANTITY	TRANSCEIVER IDENTIFICATION	LOCATION	PART NUMBER	CIRCUIT DESIGNATION
1	FTC-5010	PB-2196	G4800760	Q_{101} (3SK76)

(cut here)

YAESU MUSEN COMPANY, LTD. – C.P.O. BOX 1500, TOKYO, JAPAN
YAESU ELECTRONICS CORPORATION – 6851 Walthall Way, Paramount, CA 90723
YAESU ELECTRONICS CORPORATION – 9812 Princeton-Glendale Rd., Cincinnati, OH 45246

ORDER BLANK

QUANTITY	TRANSCEIVER IDENTIFICATION	LOCATION	PART NUMBER	CIRCUIT DESIGNATION

I authorize shipment via: ☐ Best Way ☐ Parcel Post ☐ UPS ☐ Other

Ship To: (Print or Type)
Name: _____
Address: _____
City: _____ State: _____ Zip: _____
Country: _____

YAESU MUSEN COMPANY, LTD. – C.P.O. BOX 1500, TOKYO, JAPAN
YAESU ELECTRONICS CORPORATION 6851 Walthall Way, Paramount, CA 90723
YAESU ELECTRONICS CORPORATION – 9812 Princeton-Glendale Rd., Cincinnati, OH 45246

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Ship To: Name: _____
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I authorize shipment via: ☐ Best Way ☐ Parcel Post
☐ UPS ☐ Other

Ship To: Name: _____
(Print or Type) Address: _____
City: _____ State: _____ Zip: _____
Country: _____

MAIN CHASSIS

Symbol Number	Part Number	Description
		DIODE
D1	G2090034	Si U05B
D2	G2090086	LED TLO-114
D3	G2090087	" GL-52RG
PB-2027	F0002027	LED Mounting Printed Board
	C0020270	PB-2027 with LEDs
		RESISTOR
R1	J10276471	Carbon Composition 1/2W GK 470Ω
		POTENTIOMETER
VR1(a)(b) with S1	J62800038	DM92R514A-5M2211-10KΩ Bx2
PB-2028-A	F0002028A	VR1 Mounting Printed Board
	C0020280	PB-2028 with components (VR1, D1)
		SPEAKER
SP1, SP2	M4090038	SL-45Y
		SWITCH
S1 (with VR1)	–	
S2	N6090023	SSM02223
		RECEPTACLE
J1	P1090026	SO-239
J2	P0090012	FM-146S
J3	P1090005	SG-8050-01
P2 (with wire)	T9203830	3021-04
P3 (")	T9201960B	3021-08
P4 (")	T9201970	3021-03
P5 (")	T9201990	5047-07
		POWER CORD
P6	P1090124	Power connector 3191-02R1
P6 (with wire)	T9012999A	

MAIN UNIT

Symbol Number	Part Number	Description
PB-2196	F0002196	Printed Circuit Board
	C0021960	P.C.B. with Components
		IC, FET, TRANSISTOR
Q112	G1090218	IC AN315
Q209	G1090228	" M57704H
Q215	G1090221	" MC3401P
Q401	G1090222	" MB3756
Q212	G1090220	" MLM2902
Q111	G1090072	" μPC577H
Q101, 102	G4800760	FET 3SK76
Q213	G3208560	TR 2SB856
Q214, 301	G3304580B	" 2SC458B
Q109, 110 113–117, 216	G3304600B	" 2SC460B
Q103, 106–108 201–203, 210 211	G3305350B	" 2SC535B
Q104, 204, 205	G3319060	" 2SC1906
Q105, 206, 207	G3319070	" 2SC1907
Q208	G3324070	" 2SC2407
		DIODE
D101–108, 202 203, 301	G2015550	Si 1S1555
D109, 204, 205	G2090044	" MC301
D110, 206	G2090165	Varactor FC52M-5
D201	G2090084	" MV201
		CRYSTAL
X101	–	See CRYSTAL DATA
X201, 202	–	" " "
X102	H0102050	HC-18/U 20.945 MHz
		CRYSTAL FILTER
XF101, 102	H1101990	21J2B2
		CERAMIC FILTER
CF101, 102	H3900030	LF-B15
		CERAMIC DISCRIMINATOR
CD101	H7900010	455-D
		THERMISTOR
TH101, 201	G9090011	SDT-1000
TH102, 202	G9090015	SDT-100
		RESISTOR
R237	J01245229	Carbon film ¼W TJ 2.2Ω
R225, 229, 233 242	J01245100	" " " " 10Ω
R211, 212	J01245220	" " " " 22Ω
R303	J01245330	" " " " 33Ω
R108, 219, 241	J01245470	" " " " 47Ω
R149, 160	J01245820	" " " " 82Ω
R104, 109, 110 129, 134, 205 209, 210, 238 239	J01245101	" " " " 100Ω
	J01245221	" " " " 220Ω
R235	J01245271	" " " " 270Ω
R280	J01245331	" " " " 330Ω
R165, 401, 402	J01245391	" " " " 390Ω
R114, 117, 204 221, 245	J01245471	" " " " 470Ω

R269	J01245561	Carbon film	¼W	TJ	560Ω
R120, 227	J01245681	"	"	"	"	680Ω
R124, 125, 128	J01245102	"	"	"	"	1KΩ
132, 133, 136						
143, 154, 178						
206, 220, 223						
234, 266, 270						
273, 292						
R115, 118, 135	J01245222	"	"	"	"	2.2KΩ
138, 140, 141						
222, 226, 230						
R146, 153, 162	J01245332	"	"	"	"	3.3KΩ
163, 169, 236						
283, 284						
R113, 122, 130	J01245472	"	"	"	"	4.7KΩ
159, 164, 171						
176, 202, 240						
279						
R152, 251, 253	J01245562	"	"	"	"	5.6KΩ
282						
R157, 294, 301	J01245682	"	"	"	"	6.8KΩ
	J01245822	"	"	"	"	8.2KΩ
R107, 112, 144	J01245103	"	"	"	"	10KΩ
145, 150, 168						
172, 173, 203						
207, 224, 228						
231, 262, 263						
267, 268, 271						
274, 278, 281						
285, 286, 288						
R254, 272	J01245153	"	"	"	"	15KΩ
R116, 119, 123	J01245223	"	"	"	"	22KΩ
126, 131, 161						
259, 264						
R252	J01245273	"	"	"	"	27KΩ
R101, 105, 127	J01245333	"	"	"	"	33KΩ
148, 155, 166						
170, 214, 215						
217, 248, 287						
291						
	J01245393	"	"	"	"	39KΩ
R103, 142, 151	J01245473	"	"	"	"	47KΩ
208, 216, 261						
302						
R177	J01245563	"	"	"	"	56KΩ
R277	J01245683	"	"	"	"	68KΩ
R293	J01245823	"	"	"	"	82KΩ
R156, 174, 175	J01245104	"	"	"	"	100KΩ
218, 260, 289						
290						
R257	J01245124	"	"	"	"	120KΩ
R102, 106, 137	J01245154	"	"	"	"	150KΩ
139, 265, 276						
R158, 246, 255	J01245224	"	"	"	"	220KΩ
R250	J01245334	"	"	"	"	330KΩ
R256	J01245474	"	"	"	"	470KΩ
R247, 249	J01245824	"	"	"	"	820KΩ
R258	J01245155	"	"	"	"	1.5MΩ
R213	J10246221	"	Composition	¼W	GK	220Ω
	J10216471	"	"	1/8W	GK	470Ω
	J10216561	"	"	"	"	560Ω
	J10216102	"	"	"	"	1KΩ
R121	J10246102	Carbon Composition	¼W	GK	1KΩ
	J10216472	"	"	"	"	4.7KΩ
	J10216103	"	"	1/8W	"	10KΩ
R275	J10246103	"	"	¼W	"	10KΩ
R147	J10246223	"	"	"	"	22KΩ
	J10216333	"	"	1/8W	"	33KΩ
	J10216104	"	"	"	"	100KΩ
		POTENTIOMETER				
VR202	J51724103	PN822H103H	10KΩB			
VR101, 201	J51723103	SR19R	10KΩB			
		CAPACITOR				
C143, 230, 237	K08179001	Ceramic	50WV	AH	0.5pF
		(2222 636 03507)				
C224	K02179002	"	"	CH	1.5pF
		(DD104CK1R5C50V02)				
C238, 244, 248	K02179045	"	"	CH	2pF
249		(2222 636 09208)				
C247, 250	K02172030	"	"	CH	3pF
		(DD104CH030C50V02)				
C246, 306	K02172040	"	"	CH	4pF
		(DD104CH040C50V02)				
	K05179002	"	"	RH	5pF
		(2222 636 39508)				
C147	K02179052	"	"	CH	5pF
		(2222 636 09508)				
C104	K02179054	"	"	CH	6pF
		(2222 636 09608)				
C289	K02173060	"	"	CH	6pF
		(DD104CH060D50V02)				
C149	K02179038	"	"	CH	7pF
		(2222 636 09708)				
C140	K05179005	"	"	RH	8pF
		(2222 636 39808)				
C227	K05179007	"	"	RH	10pF
		(2222 636 40109)				
C156	K02179028	"	"	CH	10pF
		(2222 636 10109)				
C144, 231	K05179008	"	"	RH	12pF
		(2222 636 40129)				
	K06179042	"	"	UJ	12pF
		(2222 637 58121)				
C110, 136	K02179048	"	"	CH	12pF
		(2222 636 10129)				
C245	K02179040	"	"	CH	15pF
		(2222 636 10159)				
C232	K05179022	"	"	RH	18pF
		(2222 637 40189)				
C218	K05179011	"	"	RH	22pF
		(2222 637 40229)				
C209, 222	K05179012	"	"	RH	27pF
		(2222 637 40279)				
C153	K06179021	"	"	UJ	33pF
		(2222 636 58339)				

C145	K05179013	Ceramic 50WV RH 33pF (2222 637 40339)	C269, 407–410	K10179015	Ceramic 50WV 0.01μF (CK45B1H103MYS)
C225	K05179015	" " RH 39pF (2222 637 40399)	C189, 252	K50177102	Mylar 50WV 0.001μF (50F2U102M)
C226	K05179015	" " RH 47pF (2222 637 40479)	C171, 183, 184	K50177222	" " 0.0022μF (50F2U222M)
C258	K02179036	" " CH 47pF (2222 637 10479)	C187, 256	K50177332	" " 0.0033μF (50F2U332M)
C132	K06179026	" " UJ 47pF (2222 637 58479)	C195	K50177472	" " 0.0047μF (50F2U472M)
C203	K06179023	" " UJ 56pF (2222 637 58569)	C182, 273, 282	K50177103	" " 0.01μF (50F2U103M)
C221	K05179016	" " RH 56pF (2222 637 40569)	C251, 260	K50177223	" " 0.022μF (50F2U223M)
C233	K02179042	" " CH 56pF (2222 637 10569)	C173, 174 176–178, 180	K50176473	" " 0.047μF (MRS-473K)
C131, 204	K06179024	" " UJ 68pF (2222 637 58689)		K70160001	Tantalum 35WV 0.047μF (MDST473F)
C155	K06179041	" " UJ 100pF (2222 637 58101)	C185	K70167104	" " 0.1μF (CS15E1V0R1M)
C197, 207	K02179049	" " CH 100pF (2222 637 10101)	C194	K70167154	" " 0.15μF (CS15E1VR15M)
	K06179042	" " UJ 120pF (2222 637 58121)		K70167224	" " 0.22μF (CS15E1VR22M)
C213, 217, 275 304	K02179032	" " CH 120pF (2222 637 10121) NP0?		K70167684	" " 0.68μF (CS15E1VR68M)
C268	K07179021	" " RH 150pF (2222 637 34151)	C186, 199, 253 255, 403	K70147105	" 25WV 1μF (CS15E1E010M)
C154	K06179022	" " UJ 220pF (2222 637 58221)	C259	K70147335	" 25WV 3.3μF (CS15E1E3R3M)
C190	K10179012	" " 330pF (2222 660 02331)	C160, 163, 175 191, 196, 215 254	K70127475	" 16WV 4.7μF (CS15E1C4R7M)
C181	K10179011	" " 470pF (2222 660 02471)	C158, 166, 172 188, 192, 0200 261, 264–266 283	K70127106	" " 10μF (CS15E1C100M)
C198	K10179013	" " 820pF (2222 660 02821)			
C103, 105, 106 108, 109, 115 117, 118, 123–125, 130 134, 137, 138 142, 146, 148 152, 159, 161 162, 168–170 179,0202–0208 202, 205, 206 212, 214, 219 234, 236, 239– 243, 257, 267 270–272, 274 276–279, 281 284, 285, 287 288, 293–297 301, 302, 303 305, 401, 411	K10179014	" " 0.001μF (CK45B1H102MY)	C280, 286	K70127336	" " 33μF (CS15E1C330M)
				K70127476	" " 47μF (CS15E1C470M)
			C262, 404–406	K40129007	Electrolytic 16WV 100μF (16RE100)
			C193, 402	K40129006	" " 470μF (16RE470)
					TRIMMER CAPACITOR
			TC202, 203	K91000060	ECV-1ZW 02x53 2pF
			TC204, 205, 207	K91000059	ECV-1ZW 04x53 4pF
			TC206	K91000028	ECV-1ZW 10x53 10pF
			TC102	K91000029	ECV-1ZW 20x53 20pF
C126–128, 133 135, 139, 141 150, 151, 157 164, 165, 167 208, 210, 216 220, 223, 228 229, 235, 263	K10179024	" " 0.01μF			
					CAVITY
			CV101	Q9000079	HRW-231MT-1019A
			CV102	Q9000080	HRQ-232MT-1009A
			CV103	Q9000081	HRW-231MT-1018A

		INDUCTOR
L102, 104, 105 114, 118, 208 213, 214	L0020675	
L109	L0020756	
L205, 207, 210	L0020674	
L211	L0020676	
L216, 217, 218	L0020677	
L110, 111, 113	L1020082	
L202, 203, 204 206	L1020081	
L215	L1020079	
L219, 220, 402	L1020080	
L117	L1190038	FL-5H 271K 270μH
L112, 115, 116 201, 224	L1190017	FL-5H 102K 1mH
L401	L2030060	
		TRANSFORMER
T102	L0020718	
T103, 104, 206 207	L0020343	113SN-3392Y
T105	L0020717	199CC-11125BWN
T106	L0020647	199CC-11114N
T107	L0020649	7MC-5896Y
T108	L0020895A	
T202	L0020897A	
T203	L0020648	
T204	L0020651	
T205	L0020346	
T208, 209	L0020429	113SN-4530Y
T210, 211	L0020896A	
		RELAY
RL301	M1190008	FBR-221D006
		CONNECTOR
J401	P0090054	5048-07A
J201	P0090090	3022-09A
J101	P0090059	3022-11A
		CRYSTAL PIN SOCKET
XS	P1090099	50865-8
		TP TERMINAL
TP	Q5000037	TP-H

ACCESSORIES

Symbol Number	Part Number	Description
		POWER CORD
	T9012904B	Power Cord Assembly
P6		Power Connector 3191-02P
	Q2000001	Fuse Holder SN1101
	Q0000006	Fuse 4A
		MICROPHONE
	M3090019	YM-30
	P1090021	Microphone Plug FM-146P
		MOUNTING BRACKET
		FMB-2-1

FTS-2

TONE SQUELCH UNIT (OPTION)

Symbol Number	Part Number	Description
PB-2029A	F0002029A	Printed Circuit Board
	C0020290	PCB with Components without Tuning Resistors
		IC & TRANSISTOR
Q701, 702, 741	G1090220	IC MLM2902
Q703, 721 742–745, 761 781, 782	G3304600B	Tr. 2SC460B
		DIODE
D701–704	G2015550	Silicon diode 1S1555
		RESISTOR
R732	J01245680	Carbon film ¼W TJ 68Ω
R717, 741	J01245101	" " " " 100Ω
R760	J01245331	" " " " 330Ω
R716, 789	J01245102	" " " " 1KΩ
R752	J01245152	" " " " 1.5KΩ
R731, 751	J01245222	" " " " 2.2KΩ
R758	J01245332	" " " " 3.3KΩ
R715	J01245472	" " " " 4.7KΩ
R756, 782	J01245562	" " " " 5.6KΩ
R784	J01245682	" " " " 6.8KΩ
R706, 709, 712 718, 753, 761 762, 767, 787	J01245103	" " " " 10KΩ
R755	J01245153	" " " " 15KΩ
R702, 750, 757	J01245223	" " " " 22KΩ
R703, 783	J01245333	" " " " 33KΩ
R749	J01245473	" " " " 47KΩ
R730, 733, 788	J01245683	" " " " 68KΩ
R754	J01245823	" " " " 82KΩ
R789	J01245104	" " " " 100KΩ
R746, 747, 759 766	J01245154	" " " " 150KΩ
R711, 742, 785	J01245224	" " " " 220KΩ
R786	J01245474	" " " " 470KΩ
R781	J01245185	" " " " 1.8MΩ

R704	J20249038	Metallic film ¼W	6.19KΩ ±1%
R707	J20249039	" " " TJ	15KΩ ±1%
R710, 713	J20249041	" " " "	22KΩ ±1%
R721–729, 744	J20249043	" " " "	82.5KΩ ±1%
R763	J20249045	" " " "	100KΩ ±1%
R714	J20249027	" " " "	121KΩ ±1%
R745	J20249044	" " " "	270KΩ ±1%
R708	J20249039	" " " "	470KΩ ±1%
R705	J20279001	" " " "	1.5MΩ ±1%
		TUNING RESISTOR	
R764			
67 Hz	J20279006	Metallic film ½W	1MΩ
71.9 Hz		(ERO-50 CHD 1004)	
74.4 Hz		±0.5%, 50 PPM	
77.0 Hz			
79.7 Hz	J20249168	" " "	562KΩ
81.0 Hz		(ERO-25 CHD 5623)	
82.5 Hz		±0.5%, 50 PPM	
85.4 Hz			
88.5 Hz			
90.0 Hz			
91.5 Hz			
94.8 Hz			
100.0 Hz			
103.5 Hz	J20249169	" " " "	442KΩ
107.2 Hz		(ERO-25 CHD 4423)	
110.9 Hz			
114.8 Hz	J20249170	" " " "	300KΩ
118.8 Hz		(ERO-25 CHD 3003)	
123.0 Hz			
127.3 Hz			
131.8 Hz			
136.5 Hz			
141.3 Hz			
146.2 Hz	J20249171	" " "	137KΩ
151.4 Hz		(ERO-25 CHD 1373)	
156.7 Hz			
162.2 Hz			
167.9 Hz			
169.0 Hz			
173.8 Hz			
179.9 Hz			
186.2 Hz	J20249092	" " "	68.1KΩ
188.0 Hz		(ERO-25 CHD 6812)	
192.8 Hz			
203.5 Hz			
209.0 Hz			
210.7 Hz			
218.1 Hz			
225.7 Hz			
233.6 Hz			
241.8 Hz			
250.3 Hz			
R765		(ERO-25 CHD TYPE	
		±0.5%, 50 PPM)	
67 Hz	J20249172	Metallic film ¼W	374KΩ
		(ERO-25 CHD 3743)	
71.9 Hz	J20249173	Metallic film ¼W	191KΩ
		(ERO-25 CHD 1913)	
74.4 Hz	J20249196	" " "	115KΩ
		(ERO-25 CHD 1153)	
77.0 Hz	J20249174	" " "	40.2KΩ
		(ERO-25 CHD 4022)	
79.7 Hz	J20249197	" " "	407KΩ
		(ERO-25 CHD 4073)	
81.0 Hz	J20249198	" " "	379KΩ
		(ERO-25 CHD 3793)	
82.5 Hz	J20249175	" " "	344KΩ
		(ERO-25 CHD 3443)	
85.4 Hz	J20249199	" " "	284KΩ
		(ERO-25 CHD 2843)	
88.5 Hz	J20249176	" " "	226KΩ
		(ERO-25 CHD 2263)	
90.0 Hz	J20249200	" " "	200KΩ
		(ERO-25 CHD 2003)	
91.5 Hz	J20249201	" " "	174KΩ
		(ERO-25 CHD 1743)	
94.8 Hz	J20249177	" " "	124KΩ
		(ERO-25 CHD 1243)	
100.0 Hz	J20249095	" " "	54.9KΩ
		(ERO-25 CHD 5492)	
103.5 Hz	J20249064	" " "	133KΩ
		(ERO-25 CHD 1333)	
107.2 Hz	J20249178	" " "	95.3KΩ
		(ERO-25 CHD 9532)	
110.9 Hz	J20249179	" " "	59.7KΩ
		(ERO-25 CHD 5972)	
114.8 Hz	J20249079	" " "	169KΩ
		(ERO-25 CHD 1693)	
118.8 Hz	J20249171	" " "	137KΩ
		(ERO-25 CHD 1373)	
123.0 Hz	J20249086	" " "	107KΩ
		(ERO-25 CHD 1073)	
127.3 Hz	J20249070	" " "	80.6KΩ
		(ERO-25 CHD 8062)	
131.8 Hz	J20249095	" " "	54.9KΩ
		(ERO-25 CHD 5492)	
136.5 Hz	J20249180	" " "	30.9KΩ
		(ERO-25 CHD 3092)	
141.3 Hz	J20249181	" " "	8.87KΩ
		(ERO-25 CHD 8871)	
146.2 Hz	J20249182	" " "	152KΩ
		(ERO-25 CHD 1523)	
151.4 Hz	J20249183	" " "	132KΩ
		(ERO-25 CHD 1323)	
156.7 Hz	J20249184	" " "	114KΩ
		(ERO-25 CHD 1143)	
162.2 Hz	J20249185	" " "	97.6KΩ
		(ERO-25 CHD 9762)	
167.9 Hz	J20249186	" " "	81.6KΩ
		(ERO-25 CHD 8162)	
169.0 Hz	J20249202	" " "	78.7KΩ
		(ERO-25 CHD 7872)	
173.8 Hz	J20249187	" " "	67.3KΩ
		(ERO-25 CHD 6732)	
179.9 Hz	J20249188	" " "	53.6KΩ
		(ERO-25 CHD 5362)	
186.2 Hz	J20249189	" " "	110KΩ
		(ERO-25 CHD 1103	

R765		
188.0 Hz	J20249203	Metallic film ¼W 106KΩ (ERO-25 CHD 1063)
192.8 Hz	J20249185	" " " 97.6KΩ (ERO-25 CHD 9762)
203.5 Hz	J20249070	" " " 80.6KΩ (ERO-25 CHD 8062)
209.0 Hz	J20249204	" " " 73.2KΩ (ERO-25 CHD 7322)
210.7 Hz	J20249190	" " " 70.6KΩ (ERO-25 CHD 7062)
218.1 Hz	J20249191	" " " 61.9KΩ (ERO-25 CHD 6192)
225.7 Hz	J20249192	" " " 53.0KΩ (ERO-25 CHD 5302)
233.6 Hz	J20249193	" " " 44.8KΩ (ERO-25 CHD 4482)
241.8 Hz	J20249194	" " " 37.4KΩ (ERO-25 CHD 3742)
250.3 Hz	J20249195	" " " 30.5KΩ (ERO-25 CHD 3052)
		POTENTIOMETER
VR701	J51724203	PN822H 203H 20KΩB
VR734, 748	J51724103	" 103H 10KΩB
VR743	J51724303	" 303H 30KΩB
		CAPACITOR
C763	K02179037	Ceramic 50WV 68pF (2222 637 10689)
C742, 762	K23170004	" " 3900pF (PRE 111 CH 392J50V10)
C722	K55209001	Mylar 100WV 1040pF (PRA1041F 1040pF)
C712, 724	K55209002	" " 1500pF (PRA1501F 1500pF)
C702–711	K55209003	" " 4700pF (PRA4701F 4700pF)
C726	K55209004	" " 7100pF (PRA7101F 7100pF)
C713	K55209005	" " 8710pF (PRA8711F 8710pF)
C725	K55209006	" " 0.0328μF (PRA3282F 0.0328μF)
C723	K55209007	" " 0.033μF (PRA3302F 0.033μF)
C721	K55209008	" " 0.047μF (PRA4702F 0.047μF)
C701, 714, 729	K70167105	Tantalum 35WV 1μF (CS15E1V010M)
C727, 728, 743–747, 761 781, 782	K70127106	" 16WV 10μF (CS15E16V100M)
C781	K40129008	Electrolytic 16WV 33μF (16RE33)
C715, 741	K40129002	" 16WV 47μF (16RE47)
		CONNECTOR
P711	P1090195	3021–05 (with wire T9204030A)
P714	P1090186	3021–04 (with wire T9204040A)
		RESISTOR PIN SOCKET
	P1090093	2–331272–5

AC POWER SUPPLY
FP-5

MAIN CHASSIS

Symbol Number	Part Number	Description
		TRANSISTOR
Q1	G3090014	2N3055
		DIODE
D1	G2090022	S5VB
		CAPACITOR
C1	K43160002	Electrolytic 35WV 10000μF (35L 10000)
		POWER TRANSFORMER
PT1	L3030016	
		AC FUSE HOLDER
FH1	P2000017	SN2050
		AC FUSE
F1	Q0000003	2A 100V–117V
	Q0000002	1A 200V–234V
		SWITCH
S1	N2000015	8M2011
	S6000028	8Z0013 (Black knob)
		SPEAKER
SP1	M4090034	SE-77KY-T
		METER
M1	M0290014	
		PLUG
P2	P0090034	P-2240 (SP)
P1 (with wire)	T9013099A	3191-02P (DC OUT)
		AC CORD
	T9000580	2 wire, 2 prong plug
	T9000482	3 wire, 3 prong plug (UL)
	T9000684	3 wire, 2 prong EU plug
	T9000680	3 wire, 3 prong Australian plug

REGULATOR UNIT

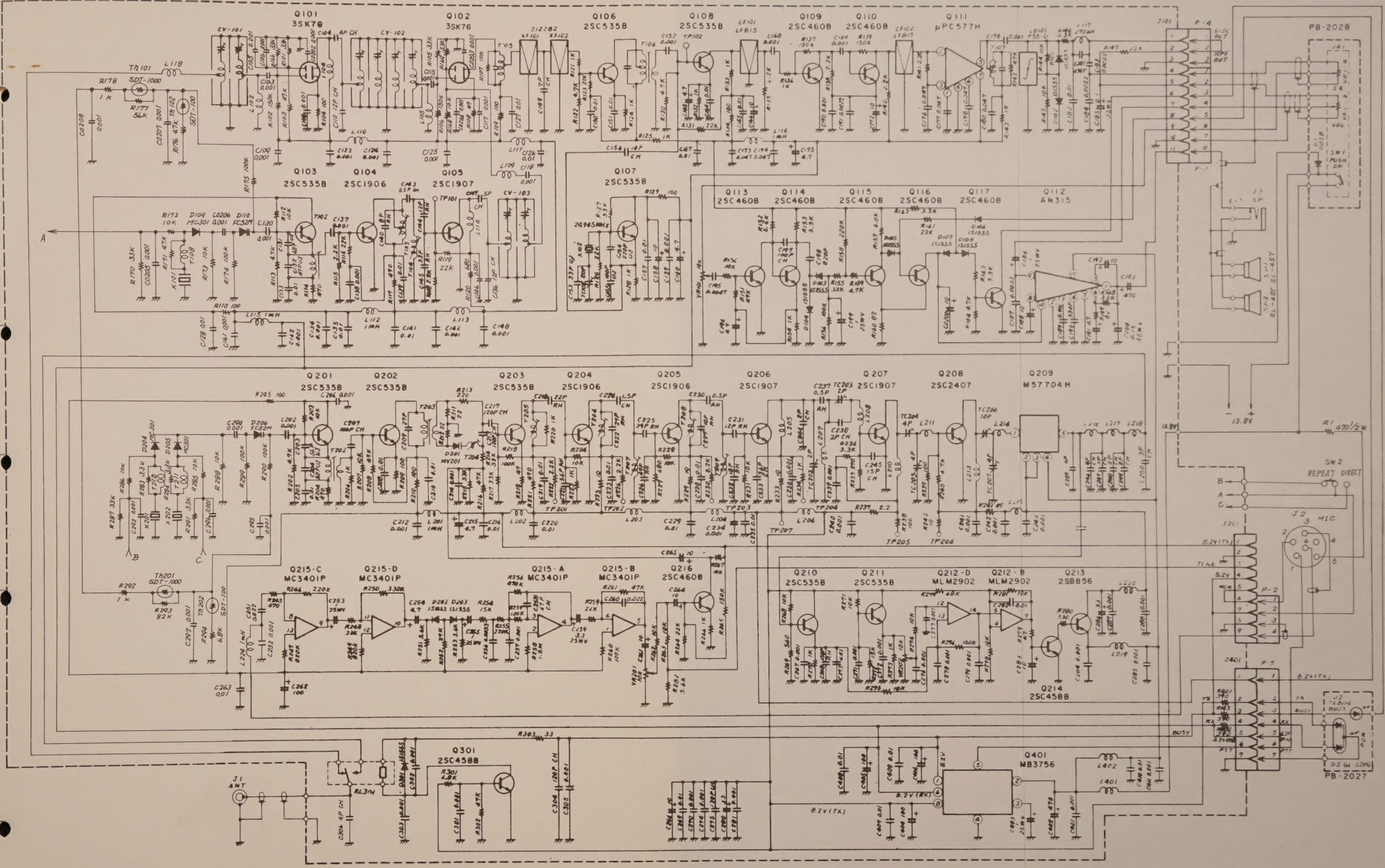
Symbol Number	Part Number	Description
PB-2025	F0002025	Printed circuit board
	C0020250	P.C.B. with components
		IC & TRANSISTOR
Q101	G1090036	IC TA7089M
Q102	G3408800O	TR 2SD880 (O)

		RESISTOR
R101	J01245101	Carbon film ¼W TJ 100Ω
R104	J01245221	" " " " 220Ω
R102	J01245332	" " " " 3.3KΩ
R105	J01245103	" " " " 10KΩ
R103	J01245123	" " " " 12KΩ
R109	J01245124	" " " " 120KΩ
R108	J01276151	" composition ½W GK 150Ω
R107	J01276471	" " " " 470Ω
R106	J30376029	Cement 5W 0.2Ω (SQ51)
		POTENTIOMETER
VR101	J50702202	EVL S0A 00B23 2KΩB
		CAPACITOR
C102	K14170103	Ceramic 50WV 0.01μF (DB201ZF103Z5L5)
C103	K50177103	Mylar 50WV 0.01μF (50F2U 103M)
C104	K50177104	" " 0.1μF (50F2U 104M)
C101	K41140108	Electrolytic 25WV 1000μF (ECEA25V-1000U)
		DC FUSE HOLDER
FH101	P2000003	F-3265
		DC FUSE
F101	Q0000006	4A
	Q5000011	Wrapping terminal C

ACCESSORIES

Symbol Number	Part Number	Description
		AC FUSE
	Q0000003	2A (100V–117V)
	Q0000002	1A (200V–234V)
		DC FUSE
	Q0000006	4A

PB-2196



CIRCUT DIAGRAM

FTC-5010

8009-G

Printed in Japan